

PERSONALITY, MOTIVES, AND SUBSTANCE USE AMONG OPIOID AGONIST
THERAPY CLIENTS

by

Ioan Tiberiu Mahu

Submitted in partial fulfilment of the requirements
for the degree of Doctor of Philosophy

at

Dalhousie University
Halifax, Nova Scotia
July, 2022

Dalhousie University is located in Mi'kma'ki,
the ancestral and unceded territory of the Mi'kmaq.
We are all Treaty people.

© Copyright by Ioan Tiberiu Mahu, 2022

DEDICATION

I would like to dedicate this work to the numerous research participants who have generously and altruistically donated their time, knowledge, and experiences to the benefit of science. Without your collaboration, none of this would be possible.

TABLE OF CONTENTS

DEDICATION.....	ii
LIST OF TABLES.....	viii
LIST OF FIGURES.....	ix
ABSTRACT.....	x
LIST OF ABBREVIATIONS USED.....	xi
ACKNOWLEDGEMENTS.....	xiii
CHAPTER 1: GENERAL INTRODUCTION.....	1
Opioid Agonist Therapy.....	1
The Opioid Crisis.....	1
Buprenorphine/Naloxone.....	3
Methadone Maintenance Therapy (MMT).....	4
Polysubstance Use.....	4
Motivational Models of Substance Use.....	6
Incentive Motivation Model.....	7
Theoretical Typologies.....	8
Limitations of the motivational literature.....	11
Four-Factor Personality Model of Substance Use Vulnerability.....	12
Externalizing or Disinhibited Traits.....	16
Internalizing or Inhibited Traits.....	18
Personality-Targeted Treatment.....	21
Limitations of the Four-Factor Personality Vulnerability Model.....	22
Summary.....	27
Dissertation Aims.....	27
Study 1.....	28
Study 2.....	29
Study 3.....	30
Outline.....	30
CHAPTER 2. STUDY 1: SPECIFICITY OF PERSONALITY RELATIONSHIPS TO PARTICULAR FORMS OF CONCURRENT SUBSTANCE USE AMONG METHADONE MAINTENANCE THERAPY CLIENTS.....	31
Abstract.....	32

Introduction.....	33
Personality Model of Substance Use Vulnerability	33
Present Study	35
Materials and Methods.....	37
Participants.....	37
Procedure	37
Statistical Analyses	38
Results.....	40
Discussion.....	41
Personality correlates of substance use among MMT clients.....	41
Limitations	44
Conclusions.....	45
Tables.....	46
CHAPTER 3. TRANSITION FROM STUDY 1 TO 2	54
Motives by Substance	54
Alcohol and Drinking Motives	54
Tobacco/Nicotine and Smoking Motives.....	55
Cannabis and Cannabis Use Motives.....	57
Stimulant Drugs and Stimulant Use Motives.....	59
Opioids and Opioid Use Motives.....	61
Tranquiliser Drugs and Motives for Tranquiliser Use.....	63
Conclusion	64
Figures.....	66
CHAPTER 4. STUDY 2A: DIFFERENT DRUGS COME WITH DIFFERENT MOTIVES: EXAMINING MOTIVES FOR SUBSTANCE USE AMONG POLYSUBSTANCE USERS UNDERGOING METHADONE MAINTENANCE THERAPY (MMT).....	67
Abstract.....	68
Introduction.....	70
Objectives and Hypotheses	72
Method	73
Participants.....	73
Procedure	74

Materials	74
Statistical Analysis.....	76
Results.....	78
Discussion.....	82
External Motives.....	82
Internal Motives.....	83
Limitations	85
Conclusions.....	87
Tables.....	88
CHAPTER 5. TRANSITION FROM STUDY 2A to 2B.....	96
CHAPTER 6. STUDY 2B: MOTIVATIONS FOR SUBSTANCE USE AMONG OPIOID AGONIST THERAPY CLIENTS, INTERACTIONS BETWEEN PERSONALITY AND SUBSTANCE TYPE	98
Abstract.....	99
Introduction.....	101
Methods.....	105
Participants.....	105
Materials	105
Statistical Analysis.....	107
Results.....	108
Personality Main Effects.....	109
Personality Interactions.....	109
Discussion.....	111
Sensation Seeking.....	112
Impulsivity	113
Hopelessness.....	116
Anxiety Sensitivity.....	117
Strengths and Limitations	119
Conclusion	119
Tables.....	121
Online Supplementary Tables.....	128
CHAPTER 7. TRANSITION FROM STUDY 2 TO 3	135

CHAPTER 8. STUDY 3A: The Four-Factor Personality Model and its Qualitative Correlates among Methadone Maintenance Therapy (MMT) Clients.....	138
Abstract.....	139
Introduction.....	141
Four-Factor Personality Model.....	142
Methods.....	144
Participants.....	144
Data Collection	144
Results.....	147
Internalizing and Externalizing Symptoms.....	147
Adverse Experiences.....	154
Substance Use	156
Discussion.....	158
Personality Targeted Model.....	159
Limitations	162
Conclusions.....	163
Acknowledgements.....	164
Tables.....	165
CHAPTER 9. GENERAL DISCUSSION	173
Summary and Integration of Findings	173
Summary: Study 1.....	173
Summary: Study 2A.....	177
Summary: Study 2B.....	180
Summary: Study 3.....	185
Integration.....	188
Discrepancies Between Studies	191
Theoretical Implications	194
Four Factor Personality Vulnerability Model.....	194
Motivational Model for Substance Use	203
Clinical Implications.....	207
Personality-Targeted Treatment.....	207
Strengths and Limitations	209
Limitations	210

Strengths	214
Directions for Future Research	215
Conclusions	219
REFERENCES	221
APPENDIX A. COPYRIGHT PERMISSION TO INCLUDE STUDY 1	258
APPENDIX B. DEMOGRAPHIC QUESTIONNAIRE	259
APPENDIX C. SUBSTANCE USE RISK PROFILE SCALE (SURPS)	261
APPENDIX D. SUBSTANCE USE QUESTIONNAIRE.....	263
APPENDIX E. COPYRIGHT PERMISSION TO INCLUDE STUDY 2	266
APPENDIX F. MOTIVES FOR USE QUESTIONNAIRE	267
APPENDIX G. PRACTITIONER AND CLIENT PERSPECTIVES ON ADAPTING PERSONALITY TARGETED INTERVENTIONS FOR USE AS AN ADJUNCT TO METHADONE MAINTENANCE THERAPY	270
APPENDIX H. DATA COLLECTION PROTOCOL.....	286
APPENDIX I. SEMI-STRUCTURED INTERVIEW GUIDE	289

LIST OF TABLES

Study 1 Table 1. Participant Demographics (N = 138).....	46
Study 1 Table 2. Participant Substance Use History (N = 138).....	48
Study 1 Table 3. Substance Use Risk Profile Scale Mean Scores, Internal Consistency, and Intercorrelations between personality factors. (n = 138)	49
Study 1 Table 4. Bayesian Confirmatory-Factor Analysis of the Substance Use Risk Profile Scale	50
Study 1 Table 5. Personality and Substance Use Outcomes.....	51
Study 2A Table 1. Study Hypotheses by Motive.....	88
Study 2A Table 2. Past 30-day Substance Use and Non-Prescribed Use.....	89
Study 2B Table 1. Percentage of Posterior Distribution with Positive Slope Values for Main Effects and Personality by Drug Class Interactions	121
Study 2B Table 1S. (excel file).....	128
Study 2B Table 2S. (excel file).....	128
Study 2B Table 3S. Personality by Drug Class Interaction Slopes for Enhancement Motives	128
Study 2B Table 4S. Personality by Drug Class Interaction Slopes for Social Motives..	129
Study 2B Table 5S. Personality by Drug Class Interaction Slopes for Expansion Motives	130
Study 2B Table 6S. Personality by Drug Class Interaction Slopes for Coping with Anxiety Motives.....	131
Study 2B Table 7S. Personality by Drug Class Interaction Slopes for Coping with Depression Motives	132
Study 2B Table 8S. Personality by Drug Class Interaction Slopes for Conformity Motives	133
Study 2B Table 9S. Personality by Drug Class Interaction Slopes for Coping with Withdrawal Motives.....	134
Study 3 Table 1. Participant Demographics	165
Study 3 Table 2. Internalizing and Externalizing Symptoms by Personality Group	167
Study 3 Table 3. Adversity Experiences by Personality Group.....	168
Study 3 Table 4. Drug Type by Personality.....	169
Study 3 Table 5. Motives for Substance Use Excerpts.....	170
Study 3 Table 6. Motives for Substance Use Endorsement by Personality Type.....	172
Table D1. Summary of findings across all studies	190

LIST OF FIGURES

Study 1 Supplementary Figure 1: Leave One Out Pareto Smoothed Importance Sampling Diagnostic (LOO-PSIS) Plot.....	52
Study 1 Supplementary Figure 2. Graphical Posterior Predictive Check for the 23-SURPS items.....	53
Bridge Chapter Figure 1. Polysubstance Use Pattern in recruited MMT sample (n=138)	66
Study 2A Figure 1. Motive endorsement by Drug Class	90
Study 2A Figure 2. Motives Ranked by Descending Order of Endorsement Across Drug Categories	91
Study 2A Figure 3. Pairwise Drug Contrasts.....	92
Study 2A Online Supplementary Figure 1. Motive endorsement by Drug Class in Covariate Adjusted Models (N = 131).....	93
Study 2A Online Supplementary Figure 2. Pairwise Drug Contrasts Posterior Distributions by Motive	94
Study 2A Online Supplementary Figure 3. Withdrawal Motives and Interactive Effects of Methadone Dosage by Drug Class.....	95
Study 2B Figure 1. Posterior distribution of slope estimates for interaction effects	123
Study 2B Figure 2. Sensation-Seeking and Drug Class Interactions.....	124
Study 2B Figure 3. Impulsivity and Drug Class Interactions	125
Study 2B Figure 4. Hopelessness and Drug Class Interactions	126
Study 2B Figure 5. Anxiety-Sensitivity and Drug Class Interactions	127

ABSTRACT

Background: The Four Factor Personality Vulnerability model (Castellanos-Ryan & Conrod, 2012; Conrod, Pihl, et al., 2000) implicates four personality traits in conferring vulnerability to substance misuse: sensation seeking (SS), impulsivity (IMP), anxiety sensitivity (AS), and hopelessness (HOP). Although the role of these personality traits has been well studied in the development of substance use behaviors, less is known about the impact of this model among a population at a later stage of addiction. My dissertation sought to understand how these four traits are involved in the maintenance of addictive behaviour among methadone maintenance therapy (MMT) clients. **Method:** Across four separate analyses, using both quantitative and qualitative methodologies, I investigated the role of personality in a sample of 138 MMT clients recruited across four different MMT clinics in two Canadian provinces. Study 1 validated the Substance Use Risk Profile Scale (SURPS; Woicik et al., 2009) in this population using Bayesian Confirmatory Factor Analysis. Study 2A developed and tested a novel substance use motives measure to investigate the motivational dynamics of polysubstance use. Study 2B extended these results to also examine interactions between personality and drug class. Study 3 recruited 20 MMT clients scoring high on one of the four personality traits who underwent a semi-structured interview. Interviews were transcribed; thematic analysis was used to code for relevant themes and content analysis was used to examine relative endorsement of thematic codes across each personality type. **Results:** The SURPS is an appropriate clinical instrument among MMT clients (Study 1). Further, personality is associated with specific forms of recent substance misuse (Study 1) and motives for use (Study 2B). Motives for use vary significantly by drug class, with different motives showing varying levels of state/trait properties (Study 2A). Finally, the relative endorsement of various themes across each personality type suggests a unique cognitive-behavioral profile specific to each trait (Study 3). **Conclusions:** Taken together, my research suggest that personality is important in explaining the maintenance of substance use behaviours among MMT clients. My dissertation therefore supports the development of personality-matched interventions as a supplement to MMT and a novel tool for fighting the opioid epidemic.

LIST OF ABBREVIATIONS USED

Abbreviation	Meaning
ACT	Acceptance and Commitment Therapy
AS	Anxiety-Sensitivity
CBT	Cognitive Behavioral Therapy
CCSA	Canadian Centre for Substance Abuse
CDC	Centre for Disease and Control
CFA	Confirmatory Factor Analysis
CI	(Bayesian) Credible Interval
DBT	Dialectical Behavioral Therapy
DMQ-R	Drinking Motives Questionnaire - Revised
E-BFMI	Estimated Bayesian Fraction of Missing Information
ELPD	Expected log pointwise prediction density
HOP	Hopelessness
ICC	Intra-Class Correlational Coefficient
IMP	Impulsivity
LMM	Linear Mixed Modeling
LOO	Leave-one-out
MCMC	Markov Chain Monte Carlo
MET	Motivational Enhancement Therapy
MMT	Methadone Maintenance Therapy
OAT	Opioid Agonist Therapy

PPC	Posterior Predictive Check
PSIS	Pareto Smoothed Importance Sampling
PTSD	Post-Traumatic Stress Disorder
ROPE	Region of practical equivalency
SD	Standard Deviation
SE	Standard Error
SS	Sensation-Seeking
SUD	Substance Use Disorder
SURPS	Substance Use Risk Profile Scale

ACKNOWLEDGEMENTS

First and foremost, I want to express my gratitude to my dissertation supervisor, Dr. Sherry Stewart. I had always been interested in personality, motivation, and addiction, and Dr. Stewart offered me the possibility of researching all three topics. Her reputation, of course, preceded her, and I was beyond ecstatic when I was offered a coveted spot in Dalhousie's clinical psychology program. I first met Dr. Stewart in February of 2015, when she kindly invited me to Halifax to meet the lab and other faculty. Dr. Stewart also took the extra step of inviting me to her home for brunch, which was prepared by her daughters. I arrived at Dr. Stewart's house that morning feeling quite embarrassed as I was completely drenched walking there from my hotel (in typical Halifax fashion, my visit coincided with the largest snowstorm of the year). Brian, her husband, gracefully lent me a dry set of clothes. So there I was – barefoot, and wearing someone else's pants – acutely aware that I was meeting one of the most accomplished addiction researchers for the first time. And yet, Dr. Stewart and her family's welcoming openness and kindness made me feel completely at ease.

I share this story here because while her academic achievements speak for themselves, this is an example of Dr. Stewart's incredible humanity, kindness, and support; qualities well known to all who have had the privilege of working with her. Dr. Stewart has truly been dedicated to my learning and has been a driving force to my academic success. Despite receiving hundreds of emails per day, she always took the time to reply to my many queries very quickly. It has truly been a privilege collaborating on these projects with her. Seeing how deeply she thinks about these topics has been humbling and motivated me to develop as a researcher. She has always provided timely

feedback and helped me revise my drafts into publishable manuscripts. Sherry, I am truly thankful to have had you as a mentor for these past seven years; and I would not be the person who I am today without your guidance and the many opportunities you so kindly entrusted to me.

I would also like to thank the remaining members of my dissertation committee. Dr. Simon Sherry has aided me when I was drafting my dissertation plan, which I presented in an advanced research methods class he was teaching. He has aided me in thinking about the pros and cons of different research methodologies, and critically evaluate the strengths and limitations of my own work. Dr. Sean Barrett shared with me his vast expertise on polysubstance use and psychopharmacology. His quiet assurance and his mysterious but oddly encouraging winks guided my thinking when I felt I was out of my depth. Dr. Jasmin Vassileva generously served as my external examiner, despite living halfway across the world. I am proud and grateful to have been examined by this illustrious committee.

Next, I would like to extend my thanks and gratitude to other mentors and collaborators. Dr. Patricia Conrod helped me develop an interest in personality-targeted research in the year prior to graduate school and has continued to inform and support my work not only as a co-author on these publications but also in training me on delivering personality-targeted interventions. Dr. Sean MacKinnon took me under his wing in his consulting practice and taught me both how to develop and to become confident in my statistical abilities. Despite not having a formal supervisory relationship with him, Dr. MacKinnon has been so kind and generous with his time and patience in mentoring me. Dr. Mike Lawrence was instrumental in introducing me to Bayesian statistics. He has

further helped me develop the analytical strategy of my first dissertation study, which I undertook as my project in his multivariate statistics class.

This work would not have been possible without the help of numerous research coordinators at each site. I would like to thank Aïssata Sako and Jennifer Swansburg who have been instrumental in getting this project up and running, as well as the numerous research assistants that have helped with data collection, entry, and transcription. The funding agencies that have supported my work include the following: the Killam Trustees (Killam Predoctoral Scholarship), the Nova Scotia Health Research Foundation (Scotia Scholar), the Nova Scotia Research and Innovation Graduate Scholarship fund (NSGS), the Canadian Institute of Health Research (CIHR CGS-M), and the Fonds de recherche du Québec – Santé (FRQS). The research in my dissertation was funded by a CIHR-funded CRISM demonstration project grant.

Next, I would like to thank my mother (Carmen Mahu) and father (Marian Mahu) for the many unspoken sacrifices they made to give me the opportunities I have had. They left Romania with nothing in the hopes that their children would have a better life, and I aim to honor their decision through the pursuit of higher education and a meaningful career. Additionally, I would like to thank my friends for their support. My residency cohort (Emily Saunders and Hannah Mohun) have kept me afloat during the many late nights and weekends writing this manuscript after doing clinical work full-time. My prairie companion, Jesse Agrey, politely pretended to be interested in my research and provided encouragement. My friends (Tara Magill, Lev Kokotov, Zi Yang Cui, Emre Fertan, Sara Bartel, Jason Isaacs, Meghan Rossi, Eli Otis, Christiane

Whitehouse, and Sarah Peverill) have supported me from through ups and downs. My two cockatiels (Keeva and Pepper) cheered me up on good and bad days.

Finally, I cannot begin to express how grateful I am to my partner Toni Spinella. Despite living halfway across the country, she supported my writing efforts in so many ways, including ordering Chinese food to be delivered at my door, sending surprise gifts, and scheduling massage appointments for me. She has showered me with unconditional support, love, and encouragement, not only through the writing of this dissertation but through everything that I do.

CHAPTER 1: GENERAL INTRODUCTION

My dissertation examines the role of personality and motives for substance use in the substance use behaviour of methadone maintenance therapy (MMT) clients. It consists of four publication-style manuscripts, examining data provided by 138 MMT clients across two Canadian provinces and four different methadone clinics. The first manuscript tested the concurrent validity of an existing personality instrument among MMT clients. The second developed and tested a novel motives measure and examined differences in substance use motives across different drug categories. The third is an extension of the analyses from the second study and examines the interactive effect of personality and drug class on motive endorsement. The fourth is a qualitative study examining the lived experience of a subset of 20 of the original sample of MMT clients who scored highly on four different personality traits. Before presenting these findings in greater depth, I will introduce opioid agonist therapy, motivational models of substance use, personality models of addiction, and the objectives of my research.

Opioid Agonist Therapy

The Opioid Crisis

The opioid crisis is devastating individuals, families, and communities across North America. Prescription opioid misuse (e.g., using a prescribed opiate without a prescription, outside of its intended purposes, or in excessive quantities) has emerged as a major health concern in North America (Haydon et al., 2005). Certain prescription drugs, such as opioids, tranquilisers (i.e., sedative-hypnotic drugs), and stimulants are understood to have a high addiction potential (Compton & Volkow, 2006). Prescription opioids have been prescribed to

13.1% of Canadians in 2015; of those with opioid prescriptions, 2.2% reported using opioids for non-medical purposes (Canadian Centre on Substance Use and Addiction [CCSA], 2017).

Prescription opioids are estimated to pose an addiction risk of about 5.5% (Busse et al., 2017), leading to an estimated cost of \$3.5 billion for Canadians in 2014 (Canadian Substance Use Costs and Harms Scientific Working Group, 2018). Rates of hospitalization due to opioid poisoning have also increased by 30% in the 2014-2015 year when compared to 2007-2008, signaling a worsening of the opioid crisis in Canada (CCSA, 2017). Outside of the morbidity posed by the opioid threat, misuse of these medications also poses a greater risk through the danger of overdosing.

Opioid-related mortality has been on a steady rise in the past few decades, now reaching epidemic proportions. Overdose rates have increased by five-fold over the past 20 years (Centers for Disease Control and Prevention [CDC], 2017). These numbers have increased further since the beginning of the COVID-19 pandemic, with Canadian data suggesting a concerning 95% increase in opioid toxicity deaths during the first year of the pandemic (Special Advisory Committee on the Epidemic of Opioid Overdoses, 2022). Mortality and morbidity from opioids are likely to worsen given the recent introduction and proliferation of powerful synthetic opioids such as fentanyl and carfentanil into the Canadian market. These appear to be fueling the opioid crisis despite more recent decreases in dispensing practices (CCSA, 2017). Recent data directly linked fentanyl with 72% of accidental opioid-related deaths in Canada, representing an 81% increase from the year prior (Special Advisory Committee on the Epidemic of Opioid Overdoses, 2018). Street drugs (e.g., heroin, cocaine) are also increasingly being cut with fentanyl, leading to a surge in accidental overdoses. According to 2017 data collected by Health Canada's Drug Analysis Service (DAS), which tests samples of seized narcotics across the country, there has

been a 2000% rise in street drug samples testing positive for fentanyl when compared with samples from 2012. For example, only about 0.08% of seized heroin samples tested positive for fentanyl in 2012, whereas recent data from 2017 indicates that 60.1% of samples tested positive (Miller & Ireland, 2017).

Given the progression and escalation of the opioid crisis, opioid use disorder is now one of the greatest challenges facing the Canadian health care system (Bruneau et al., 2018). Treatment for opioid addiction in Canada generally involves pharmacological/medication-assisted treatments such as opioid agonist therapy, although access to evidence-based treatment varies by geographical regions (CCSA, 2017; Eibl et al., 2017). In Canada, opioid agonist therapy can take several forms and includes buprenorphine–naloxone and MMT (Connock et al., 2007; Eibl et al., 2017).

Buprenorphine/Naloxone

Buprenorphine is a mu-opioid partial agonist showing efficacy in treating opioid dependence. Combined with naloxone in a sublingual tablet to mitigate abuse and dependence, it provided an opportunity for patients to receive treatment through a prescription allowing for self-administration at home, which has advantages over more traditional opioid maintenance treatment programs that often require in-person, witnessed administration (Bruneau et al., 2018; Ling et al., 2010). The most recent Canadian recommendations suggest buprenorphine-naloxone as the first standard of care due to its' improved safety profile, with MMT as a second-line choice if buprenorphine is not well tolerated or accessible (Bruneau et al., 2018). Nevertheless, both options are efficacious in treating opioid use disorder, and MMT remains widely used in Canada (Bruneau et al., 2018; Connock et al., 2007). As data collection for this dissertation took

place before the publication of these opioid treatment guidelines, when most Opiate Agonist Therapy (OAT) clients were administered MMT, this dissertation will focus on MMT.

Methadone Maintenance Therapy (MMT)

Rooted in a harm-reduction approach, individuals undergoing MMT are administered methadone, a synthetic opioid agonist, under specific and controlled dosages. After stabilization, dosages ranging between 60-120mg have shown good efficacy for suppressing opioid use, with higher dosages generally being more effective (Bao et al., 2009; Donny et al., 2002, 2005; Faggiano et al., 2003; Kennedy et al., 2013). Typically, MMT and other opioid agonist treatments have been found to be effective at reducing opioid use, overdoses, HIV risk, and criminality (Bart, 2012; Joseph et al., 2000).

Unfortunately, methadone alone fails to address some of the other characteristics that typically present among individuals with opioid addiction, including high rates of polysubstance use, relapse, and comorbid mental health difficulties, and, for some, it fails to block continued opioid use (Darke et al., 1993; Kurdyak et al., 2012; O. D. Taylor, 2015). MMT clients frequently present with co-morbid substance use disorders (SUDs) for alcohol, benzodiazepines, cocaine, and cannabis (Brands et al., 2008; Darke & Ross, 1997; Kidorf et al., 2004; White et al., 2014), underlining the failure of MMT to manage other forms of comorbid substance dependence.

Polysubstance Use

Clients in MMT frequently present with concurrent polysubstance use of numerous drugs (Crummy et al., 2020; Fulton et al., 2011; Mahu et al., 2016; O. D. Taylor, 2015), defined as using multiple drugs on the same occasion or on closely connected separate occasions (Crummy

et al., 2020). Polysubstance use is very common among opioid agonist treatment populations (Compton et al., 2021), with one recent study estimating that around 90% of individuals entering treatment for opioid use disorder engage in polysubstance use (Cicero et al., 2020).

Polysubstance use can include the use of dangerous drug combinations, such as opioids plus benzodiazepines, which has been shown to greatly increase overdose risk and harm treatment outcomes (Brands et al., 2008; Gudin et al., 2013; J. D. Jones et al., 2012; Webster et al., 2011). Reports from the Centre for Disease Control in the United States list avoiding concurrent benzodiazepines and opioids prescriptions as one of their main recommendations for combating the opioid crisis (Dowell et al., 2016), due to the dangers that concurrent use of these substances represent. Similar recommendations were made in Canada (Busse et al., 2017). Some individuals in MMT also frequently continue ‘topping up’ with opioids while in methadone treatment, as well as using other drugs such as alcohol, cocaine, and cannabis, including administering drugs via injection, a particularly risky method of drug administration (Bruneau et al., 2012). Co-use of these additional substances alongside methadone has been linked with detrimental effects. For example, co-use of opioids (including methadone) and benzodiazepines has interacting pharmacokinetic effects, explaining the historically high co-use of these drugs in opioid treatment (J. D. Jones et al., 2012), but also greatly increase overdose risk in an already vulnerable population (Gudin et al., 2013; Kerr et al., 2007). Co-use of alcohol and methadone has been found to also increase overdose risk and negatively impact cognitive performance and daily functioning (Kleykamp et al., 2015; Webster et al., 2011). The research on the effects of cannabis use while on MMT is mixed (Epstein & Preston, 2003; Mayet et al., 2015; Rosic, Kapoor, et al., 2021; Seivewright, 2003), although some recent studies caution that cannabis use predicts poorer treatment responses (Franklyn, Eibl, Gauthier, & Marsh, 2017; McBrien et al.,

2019; Zielinski et al., 2017). Poorer treatment retention was also associated with stimulant use (Franklyn, Eibl, Gauthier, Pellegrini, et al., 2017a; Greenfield et al., 1996), which also predicted greater HIV risk (Grella et al., 1997).

Indeed, polysubstance use is extremely common among MMT clients. These rates are concerning and highlight that pharmacological treatment alone does not adequately address the important comorbidities seen in opioid dependent populations (Fulton et al., 2011), particularly as it relates to comorbid substance use disorders which make recovery more difficult. Indeed, it has long been suggested that benzodiazepine using MMT clients present with more complicated clinical profiles, higher polydrug use, and poorer treatment responses (Brands et al., 2008; Darke et al., 1993; Franklyn, Eibl, Gauthier, Pellegrini, et al., 2017b; Lintzeris et al., 2006). While harm reduction approaches such as MMT and other opioid agonist programs have had positive effects for individuals suffering from opioid addiction, they could be supplemented with psychosocial treatments (Amato et al., 2008; K. W. Chen et al., 2011; Dugosh et al., 2016; Volkow et al., 2019) to treat other associated substance use and psychiatric problems from which MMT clients often suffer. Using evidence based psychosocial treatments to reduce opioid use and benzodiazepine use while on methadone may greatly enhance our treatments of opioid addiction and reduce overdose risk, providing new solutions to the emerging opioid crisis. Because of the heterogeneity across many substances of abuse, a motivational approach rooted in personality theory may present as a useful theoretical framework on which a flexible psychosocial intervention that can address polysubstance use may be built.

Motivational Models of Substance Use

Although often considered as unitary constructs by diagnostic typology systems, SUDs are highly heterogenous set of disorders with complex aetiological pathways and varied clinical

presentations (Carroll, 2021). This heterogeneity is expressed by the biopsychosocial etiology of SUDs, which includes impairments in motivational reward, affect regulation, and behavioral inhibition systems (Goodman, 2008; Koob & Volkow, 2010; Wong & Schumann, 2008). SUDs tend to be highly comorbid with other mental health problems (Conway et al., 2006) and generally have low treatment success rates that are accompanied by high relapse rates (Dawson et al., 2005, 2007; B. F. Grant et al., 2004).

Various individual difference factors, such as motives for use (Cooper, 1994; Cooper et al., 1995, 2016; Cox & Klinger, 1988; Sher, 1991; Sher et al., 2005), drug expectancies (Leventhal & Schmitz, 2006), and personality (Castellanos-Ryan & Conrod, 2012; Crews & Boettiger, 2009; Ersche et al., 2010; Franken et al., 2006; Pihl & Peterson, 1995; Stewart et al., 1997; Stewart, Chinneck, et al., 2021) have been suggested to moderate the genetic relationship between biological factors and substance use outcomes (Wong & Schumann, 2008). This phenotypic heterogeneity led to the development of theory and typological systems which attempted to better classify subgroups of individuals through the identification of common behavioral and environmental characteristics (West & Brown, 2013). Motivational models of substance use, which include proximal risk factors (e.g., motives) and more distal risk factors (e.g., personality) will be reviewed below.

Incentive Motivation Model

Understanding the reasons why people engage in substance use (i.e., motives for use) has long been a topic of immense theoretical and practical importance. From a theoretical point of view, a motivational framework can unite multiple etiological models of substance use and explain the heterogeneity seen in substance use disorders. From a practical perspective, the identification of separate etiological mechanisms implies that treatment and intervention efforts

can be tailored to specific processes that underlie substance use for different users (Cooper et al., 2016).

Cox and Klinger (1988) proposed a theory that became known as the Incentive Motivation Model, which became the most widely known motivational model of alcohol use. They asserted that the interaction between a specific intra-personal need state and an accessible environmental incentive that can satisfy this need is thought to underlie a person's motivation to use a particular substance. Thus, an individual may strategically decide to consume a substance if the specific affective changes (e.g., an increase in positive affect or a decrease in negative affect) of consuming that substance outweigh the desirable effects produced by alternative behaviours. These promoting or inhibiting factors are processed internally through a set of cognitive expectancies or beliefs about the positive or negative pharmacological and nonpharmacological effects of various substances (Cox & Klinger, 1988).

Theoretical Typologies

Although these cognitive processes that can energize and direct human behaviour may take many forms, two primary dimensions of motivation appear particularly relevant for understanding substance use behaviours, namely valence and source (Cooper, 1994; Cox & Klinger, 1988). Valence is the degree to which behavior is motivated by pursuing positive affect versus avoiding negative affect, while source is whether the behaviour is directed internally (towards the self) or externally (towards socially significant others). The product of these two dimensions leads to a number of specific substance use motives (Cooper, 1994; Cooper et al., 2016).

Approach Versus Avoidance

The pursuit of positive incentives (approach/appetitive behaviours) and the avoidance of painful incentives (avoidance/aversive behaviours) underlie the most fundamental divide of many human behaviours, and is thought to be driven by distinct neurological motivational systems (Gray, 1970, 1987). This includes the behavioral activation system (BAS), which regulates approach motivation and promotes goal-directed behaviour as well as regulating positive affect, and the behavioral inhibition system (BIS), which regulates avoidance motivation and promotes movement away from undesired outcomes as well as regulating negative affect. Individuals who are high in the BAS are theorized to be more sensitive to reward cues and predisposed to experience positive affect, while those high in BIS are prone to be hypersensitive to threat and punishment cues. These two neurobiological systems are consistent with Cox and Klinger's (1988) stipulation that individuals use substances to pursue positive outcomes or avoid negative ones, which underlies positive and negative reinforcement pathways to substance use.

Internal Versus External

This second dimension concerns the extent to which behaviors are motivated for internal (self-focused, agentic goals) versus external (social focused, communal goals) goals. Internal or self-focused goals largely derive from agentic autonomy/competence needs, driven by attempts to manage one's own emotional experience (Cooper et al., 2016). In contrast, external or other-focused goals are motivated by attachment needs, such as the need to enhance one's connection to others or maintain approval from socially significant peers (Cooper et al., 2016). While the internal dimension manipulates feeling states directly through focusing on the self, the external dimension attempts to manage emotional states more indirectly by seeking out valued outcomes from others.

Four Categories of Motives

Although Cox and Klinger's (1988) model implied the existence of four motive categories as by-products of crossing the valence and source dimensions, these motives were first identified and measured in a single assessment tool by Cooper (1994) with the publication of the Drinking Motives Questionnaire- Revised (DMQ-R). These motives include: (1) *enhancement motives*, a form of self-focused approach motive where substances are used to enhance pleasure or for excitement; (2) *coping motives*, a form of self-focused avoidance motive where substances are used to avoid or reduce negative emotions or cope with threats to self-esteem; (3) *social motives*, a form of social approach motive, where substances are used to bond with others or improve social gatherings; and finally (4) *conformity motives*, a form of social avoidance motive where substances are used to gain/maintain social approval or avoid breaking affiliative bonds. Of note, the DMQ-R (Cooper, 1994) has been slightly revised in the recent decade by V. V. Grant et al. (2007) into the Modified DMQ-R to dissociate the coping motive into coping-with-depression and coping-with-anxiety, as each was found to have clinical utility in predicting specific drinking outcomes. Large scale studies looking at relative motive endorsement in non-clinical samples suggest that social and enhancement motives were the primary reasons for drinking, followed by coping and finally conformity motives (Cooper et al., 2016; Kairouz et al., 2002).

The DMQ-R does not capture every possible motive. Other drinking motives that are not captured by Cox and Klinger's two-dimensional model include the *epicurean motive* (i.e., drinking to enjoy the taste or to enhance/accompany food), a relatively low-risk subtype of enhancement motivation, *experimentation motives* (i.e., drinking to find out what the experience is like), *identity motives* (i.e., drinking to assert one's independence or feel more mature).

Limitations of the motivational literature

Two important limitations of the motivational literature need to be acknowledged. First, as implied by the name of the DMQ-R, this scale was designed for measuring drinking motives, and thus the majority of the motivational literature using the DMQ-R has focused on alcohol use and the original four motives discussed above (Cooper et al., 2016). Because different drugs have different pharmacological effects and phenomenological experiences, it stands to reason individuals may have different motives for use across various drug categories. Indeed, several studies seem to suggest that at least half of the variance in motives for use appears to be explained by contextual factors (e.g., different situational contexts for drinking; Blevins, Abrantes, et al., 2018; Cooper et al., 2016; Demers et al., 2002; Kairouz et al., 2002). In their review of this literature, Cooper et al. (2016) examined the data from 16 different studies examining motives for use for alcohol, cannabis, and tobacco, and found differential relative endorsement of not only the main four motives, but also the presence of unique motives specific to particular substances (e.g., an automaticity motive for tobacco/nicotine).

Second, the majority of the research has focused on non-clinical samples (e.g., younger samples comprised of healthy adolescents or college students), while clinical samples at a later stage of addiction are not only more likely to have higher psychiatric comorbidities but also higher rates of polysubstance use and may present with different patterns of endorsement that are more focused on coping motives or other unique motives not captured by the DMQ-R (Blevins, Lash, et al., 2018; Gold et al., 2020; Mezquita et al., 2011; O'Hare & Shen, 2012; Rigg & Ibañez, 2010; Schlauch et al., 2015; Spencer et al., 2002; Thornton et al., 2012). For example, Blevins, Lash, et al. (2018) recruited 120 participants from an inpatient Veterans Affairs program to participate in a mixed-methods study aimed at identifying underlying motives for use that may

be unique to a clinical sample that engages in polysubstance use (opiates, alcohol, and stimulant users). They found evidence of eight motives, which included using substances (1) to help with withdrawal symptoms, (2) to counteract other substance use, (3) to cope with loneliness, (4) to deal with pain/sleep, (5) to be social/to enhance positive emotions, (6) to cope with anxiety, (7) to cope with depression, and (8) to relieve boredom/get energy. Notably, the conformity motive from the DMQ-R was not identified (which is not surprising as it is theoretically most relevant earlier on in development when peers have the most influence; Cooper, 1994).

Because clinical samples are more likely to engage in polysubstance use, it is important to not only examine substance use motives in a population at a later stage of addiction, but also examine motives for use beyond drinking. Testing the relative endorsement of these motives within a clinical sample would be valuable for designing treatment interventions that target the unique etiological pathways to various forms of substance misuse within a population that engages in polysubstance use. Because motives are hypothesized to be the final common pathway to substance use through which more distal variables can exert their effects (Cooper, 1994), examining the influence of these more distal variables in a population at a later stage of addiction can potentially enhance our understanding of how various motives are expressed. One such distal variable is personality.

Four-Factor Personality Model of Substance Use Vulnerability

The notion of identifying and labeling an “addictive personality” has captured the attention of scholars and the public alike, although efforts to attribute addictive behavior to a single personality style have not been fruitful (indeed, environmental influences also play a major role). Instead, several different personality traits appear to be implicated in predicting risk for different types of addictive behavior in various circumstances (West & Brown, 2013).

One well known early attempt to ground a theory of addiction in a more general theory of personality includes work by Cloninger (1987a, 1987b), who proposed a biosocial theory of personality outlining three dimensions of personality that were described in terms of basic stimulus-response characteristics. These characteristics included novelty seeking, harm avoidance, and reward dependence, and their interaction and combination at varying levels of intensity predicted useful heterogeneity in clinical presentations. This included Type I (low novelty seeking, high harm avoidance, high reward dependence) and Type II (high novelty seeking, low harm avoidance, low reward dependence) personality traits. This tridimensional personality theory led to early classification attempts that later differentiated between Type A alcoholism (i.e., characterized by late onset of alcohol problems, low degree of novelty seeking and psychological dependence, and high levels of negative emotions) and Type B alcoholism (i.e., characterized by early onset, antisocial behavior, high novelty seeking, and low harm avoidance; Babor et al., 1992; Brown, Babor, Litt, & Kranzler, 1994). Other well known seminal work includes neuropsychological theories examining brain systems controlling behavior and emotions; namely the aversive or behavioral inhibition system (BIS) and the appetitive or behavioral approach system (BAS), mentioned earlier in this chapter, which are both associated with addictive behavior (Franken et al., 2006; Gray, 1970, 1987). Other early personality typologies, such as Eysenck's Three-factor Personality theory (H. J. Eysenck, 1979) and the Five-Factor model of personality (Kornør & Nordvik, 2007; McCrae & Costa, 1987; Terracciano et al., 2008), although not directly derived from the field of addiction have also been widely applied to the study of susceptibility to addiction (H. J. Eysenck, 1997; Terracciano et al., 2008).

Consistent with the idea of looking at individual differences for better understanding the heterogeneity of addictive disorders, Pihl and Peterson (1995) proposed a novel theory which

attempted to explain some of the various etiological mechanisms implicated in addictive behavior by combining earlier theories of affect regulation, pharmacological susceptibility, and neuropsychological functioning. Pihl and Peterson (1995) posited that separate psychobiological systems underlie the misuse of alcohol and other drugs by mediating the response to motivationally relevant conditioned and unconditioned stimuli. Varying individual vulnerability to punishment, threat, and reward led to sensitivity to either the negative or positive reinforcement properties of various psychopharmacological substances. In other words, individual differences in substance use patterns (e.g., the heterogeneity of substance use disorders) are explained by differential pharmacological sensitivity to the reinforcing effects of alcohol and drugs, mediated by distinct neurobiological motivational systems that are manifested as different personality dimensions (Castellanos-Ryan & Conrod, 2012; Conrod, Pihl, et al., 2000; Pihl & Peterson, 1995). This theory began connecting the dots between more distal risk factors such as personality and more proximal factors such as motives.

This led to the development of the Four-Factor Personality Vulnerability Model (Castellanos-Ryan & Conrod, 2012; Conrod, Pihl, et al., 2000), which outlines that four personality-based pathways lead to unique neurocognitive and motivational profiles for use, and specific forms of substance misuse and co-occurring disorders. These four lower-order (i.e., narrowly defined, sub hierarchical structures) personality traits can be measured with the 23-item, self-report, Substance Use Risk Profile Scale (SURPS; Woicik, Stewart, Pihl, & Conrod, 2009). The SURPS scales were derived from factor analysis based on an early study with a sample of community-recruited adult substances users (Conrod, Pihl, et al., 2000). These participants completed a wide battery of questionnaires that have shown robust associations with alcohol and drug misuse, including: the NEO-Five Factor Inventory (NEO-FFI; Costa &

McCrae, 1992); the Sensation-Seeking Scale (SSS; Zuckerman et al., 1964); the trait subscale from the State-Trait Anxiety Inventory (STAI-T; Spielberger et al., 1983); the Anxiety Sensitivity Index (ASI; Peterson & Reiss, 1992); the Cognitions Checklist (CCL; Beck et al., 1987); the Beck Depression Inventory (BDI; Beck et al., 1961), the Self-Esteem Scale (SES; Rosenberg, 1965), the Posttraumatic Stress Symptom Scale-Self-Report (PSS-SR; Foa et al., 1993); the Beck Hopelessness Scale (BHS; Beck et al., 1974); and the Impulsiveness and Venturesomeness Scale (I-7; (S. B. Eysenck & Eysenck, 1978). An advantage of the SURPS over other higher-order personality measures such as the Big Five (McCrae & Costa, 1987) is that the lower order personality traits measured by the SURPS are specifically derived from previously discussed reinforcement-sensitivity models (Gray, 1987; Pihl & Peterson, 1995). This may explain why SURPS traits have been shown to be specifically associated with addiction propensity above and beyond the Big Five traits (i.e., NEO-FFI) or other longer personality inventories (e.g., the ASI, BHS, or I-7; Woicik et al., 2009). To date, multiple studies have validated the structural, concurrent, discriminant and predictive validity of the SURPS (Castellanos-Ryan et al., 2013; Jurk et al., 2015; Krank et al., 2011; Newton et al., 2016; Woicik et al., 2009) and its incremental validity beyond measures of the Big Five (e.g., Woicik et al., 2009) in youth and young adults.

Through factor analysis of the items in these scales mentioned above, four lower-order SURPS personality profiles emerged (Conrod, Pihl, et al., 2000; Woicik et al., 2009). These profiles largely fall within two main personality domains: an externalizing or disinhibited pathway comprised of impulsivity and sensation-seeking, and an internalizing or inhibited pathway comprised of hopelessness and anxiety-sensitivity. These two domains largely

correspond to the main action tendencies of behavior (approach versus avoidance), motivation (appetitive versus aversive), and affect (positive versus negative).

Externalizing or Disinhibited Traits

Both Externalizing and Internalizing dimensions are well supported in research examining the meta-structure of mental disorders, which identified a common externalizing and internalizing factor at the root of all forms of psychopathology (Carragher et al., 2015; Eaton et al., 2015). The disinhibited or externalizing domain reflects a pathway that is associated with high approach behavior, high sensitivity to appetitive cues, low sensitivity to aversive cues, and a propensity towards externalizing or behavioral problems. Although described by many separate constructs in the literature (e.g., “lack of planning”, “excitement seeking”, “low tolerance to boredom”, “acting without planning”, “under controlled”, “impulsivity”; Kirby & Finch, 2010), research suggests that the disinhibited domain can be expressed through two lower-order personality traits: sensation-seeking and impulsivity (Castellanos-Ryan & Conrod, 2012; Dawe & Loxton, 2004; Vassileva & Conrod, 2019).

Sensation-Seeking

The first of the disinhibited traits, sensation-seeking, is associated with a high need for stimulation, low tolerance to boredom, high sensitivity to reward, high willingness to take risks, and high need for novel and varied experiences (Zuckerman, 1971, 2007). A sub-dimension of extraversion, sensation-seeking is theorized to be related to substance misuse due to high sensitivity to reward leading to reward response biases and discounting of potential risks (Castellanos-Ryan et al., 2011; Castellanos-Ryan & Conrod, 2012; Vassileva & Conrod, 2019). It has been robustly associated with specific substance misuse both cross-sectionally and

longitudinally in several populations. For example, sensation-seeking has reliably been associated with alcohol use and binge drinking in youth (Castellanos-Ryan et al., 2011; Conrod et al., 2008, 2013; Krank et al., 2011; Woicik et al., 2009) and adults (Conrod, Pihl, et al., 2000; Kaminskaite et al., 2020; Long et al., 2018; Schlauch et al., 2015). Individuals scoring high in this trait experience a heightened heart rate response (an index of higher reward sensitivity) following alcohol consumption (Brunelle et al., 2004), and show greater approach reactivity to alcohol and cannabis cues (Schlauch et al., 2015). Sensation-seeking has been associated with cannabis use in youth (Krank et al., 2011; Mahu, Doucet, O’Leary-Barrett, & Conrod, 2015) and adults (Canfield et al., 2015; Hecimovic et al., 2014; Long et al., 2018). Finally, sensation-seeking has also been associated with prescription stimulant use in youth (Stewart, Chinneck, et al., 2021) and adults (Chinneck et al., 2018). Because individuals high in sensation-seeking are more sensitive to the rewarding properties of substances (Castellanos-Ryan & Conrod, 2012), they are more likely to use substances to increase positive states or affects. For example, this trait has been associated with enhancement and social motives for drinking (Comeau et al., 2001; Schlauch et al., 2015; Woicik et al., 2009), and expansion motives for cannabis use (Hecimovic et al., 2014).

Impulsivity

Impulsivity is a very broad construct with several sub-dimensions that has long been implicated in the etiology of substance use (Crews & Boettiger, 2009; Dawe & Loxton, 2004; Ersche et al., 2010; Koob & Volkow, 2010; Staiger et al., 2007; Vassileva & Conrod, 2019). Impulsivity, as measured by the SURPS, is a more narrow construct that specifically measures difficulty in response inhibition, and is distinct from sensation-seeking which primarily focuses on reward sensitivity (Castellanos-Ryan et al., 2011; Castellanos-Ryan & Conrod, 2012;

Vassileva & Conrod, 2019; Woicik et al., 2009). In the SURPS, impulsivity can be conceptualized as a lack of premeditation (i.e., a lack of forethought or acting without thinking).

Impulsivity has been associated with frequency and severity of alcohol and drug use more generally (Conrod, Pihl, et al., 2000; Vassileva & Conrod, 2019), and specifically associated with prescription stimulant use in youth (Stewart, Chinneck, et al., 2021) and stimulant use in adults (Brunelle et al., 2004; Chinneck et al., 2018; Long et al., 2018; Schlauch et al., 2015; Woicik et al., 2009). This personality trait has also been implicated in unconstrained prescription drug misuse in young adults (i.e., misusing sedative/tranquilisers, opioids, and stimulants; Chinneck et al., 2018). Although seemingly closely associated with a vulnerability towards stimulant misuse (Long et al., 2020), individuals scoring high in impulsivity typically report a motivationally undefined pattern of substance use and drinking that may be more closely related to availability and difficulty inhibiting behavior in response to substance use opportunities (Conrod, Pihl, et al., 2000; Hecimovic et al., 2014; Schlauch et al., 2015; Woicik et al., 2009). Individuals who are high in impulsivity are thought to experience difficulty regulating emotions and inhibiting behaviours, which places them at higher risk for a wide range of types of substance misuse and a disorganized pattern of motives for use (Castellanos-Ryan & Conrod, 2012; Chinneck et al., 2018; Krank et al., 2011; Mackinnon et al., 2014; Schlauch et al., 2015; Woicik et al., 2009).

Internalizing or Inhibited Traits

Neuroticism is a broad personality trait marked by negative affect and behavioral inhibition. It reflects a higher order internalizing pathway to substance misuse and co-occurring psychiatric conditions (Eaton et al., 2015; Krueger & Eaton, 2010). This pathway can in turn be broken down into two lower order factors reflecting susceptibility to distress (i.e., negative affect

or low mood) and fear, which can also be described by the lower order personality traits of hopelessness and anxiety-sensitivity, respectively (Castellanos-Ryan & Conrod, 2012).

Hopelessness

Hopelessness describes a personality profile prone to depression, consisting of low positive affect and pessimism about the future (for a discussion on state versus trait hopelessness, see Baryshnikov et al., 2018; Klein et al., 2011; Young et al., 1996). It is associated with increased vulnerability to depressive symptoms, sensitivity to punishment, lower self-esteem, higher incidence of negative thinking, and poor expectations about the future (Castellanos-Ryan & Conrod, 2012; Conrod, Pihl, et al., 2000; Gray, 1982, 1987; Woicik et al., 2009).

Hopelessness is linked to a pattern of substance use that is theorized to occur through a self-medication process aimed at numbing painful experiences and memories (Castellanos-Ryan & Conrod, 2012; Conrod, Pihl, et al., 2000; Khantzian, 1997; Pihl & Peterson, 1995). Because of increased sensitivity to punishment (negative reinforcement), individuals high on this trait are thought to be attracted towards substances that dampen this system and reduce pain, such as alcohol and opiates (Gray, 1987; Pihl & Peterson, 1995). These associations have been demonstrated empirically among youth, adults, and clinical populations. For example, hopelessness was associated with alcohol and opioid use among youth and young adults, as well as substance use motives linked to coping with depression (Chinneck et al., 2018; Stewart, Chinneck, et al., 2021; Woicik et al., 2009). Community-recruited female substance users who scored high on hopelessness were more likely than other female substance users to have an opiate use disorder diagnosis (Conrod, Pihl, et al., 2000). Additionally, inpatients at a substance use treatment facility who scored highly on hopelessness on the SURPS showed enhanced cue-reactivity to opiate cues (Schlauch et al., 2015).

Anxiety-Sensitivity

Anxiety-sensitivity is a personality style that is characterized by fear of arousal related symptoms (e.g., rapid heartbeat, sweating, feeling dizzy), which are thought to be signs of impending physical illness (e.g., suffering from a heart attack), social embarrassment (e.g., being negatively judged for appearing anxious), and/or loss of mental control (e.g., fear of losing contact with reality; Reiss et al., 1986). High levels of AS are associated with panic disorder, health anxiety, and other anxiety disorders (McNally, 2002; Stewart et al., 1999; Wright et al., 2016). While trait anxiety is the propensity to react anxiously to a variety of stressful situations (McNally, 1989), anxiety-sensitivity is characterized by a specific fear of symptoms of anxiety, and is associated with an elevated risk for anxiety disorders (e.g., panic disorder; McNally, 2002). Individuals high in this personality trait will tend to avoid activities that can produce physiological arousal (e.g., high intensity exercise, drinking coffee, substance withdrawal states), and will be particularly attracted to the tension-reducing effects of substances through a negative reinforcement, self-medication pathway of their fear, arousal, and anxiety symptoms (Castellanos-Ryan & Conrod, 2012; Conrod et al., 1998; Conrod, Pihl, et al., 2000; Stewart et al., 1997, 1999; Zvolensky et al., 2014). The overall evidence suggests that AS can be conceptualized as an arousal-accelerating factor, such that this trait confers risk for using substances to cope with stressors that induce physiological arousal, including withdrawal syndromes, trauma, social pressure, or fear (Castellanos-Ryan & Conrod, 2012).

Because of this unique vulnerability to arousal, anxiety-sensitivity has generally been linked with negative reinforcement motives for drinking and smoking (e.g., coping and conformity motives) and with increased pharmacological sensitivity to and likelihood of using substances with anxiolytic properties (Battista et al., 2008; Canfield et al., 2015; Chinneck et al.,

2018; Comeau et al., 2001; Conrod, Pihl, et al., 2000; Mackinnon et al., 2014; Stewart, Chinneck, et al., 2021). As such, the relationship between AS and substance use appears to be mediated through anxiety-symptoms and coping-with-anxiety substance use motives (Chinneck et al., 2018; Stewart et al., 1997; Woicik et al., 2009). For example, high levels of AS are associated with increased drinking and drinking problems (Stewart & Kushner, 2001), although the relationship between anxiety-sensitivity and increased alcohol use appears to be influenced by developmental processes, such that this risk presents itself most reliably in adulthood (Castellanos-Ryan & Conrod, 2012; Conrod et al., 2011; Schlauch et al., 2015; Wagner, 2001; Woicik et al., 2009). High levels of AS are also associated with smoking behavior (Guillot et al., 2016; Svicher et al., 2018), opioid use (Lejuez et al., 2006; Rogers et al., 2019) and anxiolytic use (Chinneck et al., 2018; Conrod, Pihl, et al., 2000; McHugh et al., 2017). Among opioid dependent populations, AS has been linked to increased intolerance and fear of withdrawal states, increased opioid use, higher dropout rates, and greater addiction severity (Baxley et al., 2019; Howell et al., 2010; Lejuez et al., 2006, 2008; McHugh et al., 2017; Rogers et al., 2019; Stathopoulou et al., 2021).

Personality-Targeted Treatment

A strength of the Four-Factor Personality Vulnerability model is that it led to the development of a brief and effective personality targeted treatment. This treatment is known as PreVenture and is currently implemented in the school setting as a manualized and brief, 2-session preventative group intervention. PreVenture combines elements of cognitive behavioral therapy (CBT) and motivational enhancement therapy (MET) to target personality-specific cognitive distortions and motives for use. It aims to teach youth personality-specific cognitive restructuring skills for managing their personality risk more effectively. It has been shown to be

highly efficacious for reducing substance use onset and severity, and severity of comorbid mental health problems in numerous randomized clinical trials across the western world (for a review, see Conrod, 2016). The high efficacy of this protocol despite the relative brief nature of the intervention is thought to be due to the specificity of each personality trait in terms of predicting risk of comorbid substance use and mental health problems. However, adaptations for populations other than adolescents (e.g., substance dependent populations) currently do not exist.

Limitations of the Four-Factor Personality Vulnerability Model

Although the Four-Factor Personality Vulnerability Model has been widely useful for predicting risk for *initiating* substance misuse (Castellanos-Ryan & Conrod, 2012), the extent to which it is also involved in the *maintenance* of addictive behavior remains unclear. This is because the SURPS was primarily validated in non-clinical populations comprised of adolescents or young adults. While the initial development of this theoretical model was derived from research with community-recruited substance using women (Conrod, Pihl, et al., 2000; Conrod, Stewart, et al., 2000), the subsequent validation studies of the SURPS were centered on healthy adolescents and young adults (Ali et al., 2016; Canfield et al., 2015; Castellanos-Ryan et al., 2013; Castonguay-Jolin et al., 2013; Jurk et al., 2015; Krank et al., 2011; Newton et al., 2016; Omiya et al., 2015; Woicik et al., 2009). The Four-Factor Personality *Vulnerability* model (Castellanos-Ryan & Conrod, 2012) is primarily a *predisposition/vulnerability* model, as most of the extant research is developmental. This is an important limitation, as personality measured in a later stage of the addiction process may not be involved in the maintenance of addictive behaviour in the same way it confers risk to initiating substance use behaviours.

Indeed, other models explaining the relationship between personality traits and mental health disorders (including SUDs) include pathoplasty/exacerbation models, concomitant/state

models, and scar/complication models (Durbin & Hicks, 2014). There is a great deal of overlap between these models, but they may be particularly relevant for populations at a later stage of addiction or in developmental periods other than adolescence or emerging adulthood. The pathoplasty model suggests that a trait does not directly cause a disorder, but that once the disorder develops, the trait influences the presentation or course of that disorder (Durbin & Hicks, 2014). This may explain why anxiety-sensitivity has been inconsistently linked with alcohol use in prior SURPS research (Woicik et al., 2009), as highlighted in a recent meta-analysis suggesting that AS may not confer risk for drinking but instead maintain drinking behavior, especially in the face of a stressor (Bartel et al., 2018). The concomitant/state model suggests that symptoms of mental health disorders temporarily result in behaviors which are described by different personality traits (Durbin & Hicks, 2014). For example, individuals in an acute depressive episode score higher on measures of neuroticism than when they are not acutely depressed, possibly due to biased self-reporting of negatively evaluative traits as a result of their own negative self-perceptions (Ormel et al., 2004). Symptoms of common mental health conditions can also reflect dysphoria and failures of self-regulation which may manifest in personality traits as high neuroticism or low conscientiousness (Ormel et al., 2013). Lastly, scar/complication models propose that the occurrence of a disorder changes one's personality permanently (Durbin & Hicks, 2014), which has particular relevance when examining chronic substance use. It is well known that addictive behavior can alter the reward and emotional circuits of the brain, setting the stage for the transition between experimentation with substance use to an addictive disorder (Koob & Volkow, 2010; Volkow et al., 2016).

Indeed, chronic substance use is known to have neurotoxic effects on the brain (Goldstein & Volkow, 2002), which can result in personality changes such as increased impulsivity (Crews

& Boettiger, 2009; Mendez et al., 2010; Setlow et al., 2009; Vassileva & Conrod, 2019), sensation-seeking (Ersche et al., 2010), anxiety-like experiences (Koob & Volkow, 2010), and depressive-like states (J. M. White, 2004). For example, substance induced anxiety episodes can act as a powerful learning experience which can reinforce fear of arousal sensations (i.e., AS; Stewart & Conrod, 2008). Similarly, substance induced depressive-like states (or withdrawal symptoms) may bring forth a pervasive sense of persistent hopelessness (Quello et al., 2005). Continued and prolonged stimulant misuse can have neurotoxic effects on the brain, leading to further impairments in various subfactors of impulsivity (e.g., negative urgency; Albein-Urios et al., 2012, 2013; Ersche et al., 2010; Mitchell & Potenza, 2014). Additionally, heavy drinking in college can increase impulsivity and sensation-seeking traits (Quinn et al., 2011). Long-term opioid use can result in the development of adaptations in the nervous system (i.e., drug-opposite responses) which cause mood disturbances or increases in neuroticism (J. M. White, 2004). Whether these effects on personality are permanent (i.e., scar models) or temporary (i.e., state models), there is at the very least a bi-directional relationship between personality and substance misuse.

As the SURPS has mostly been used to predict risk for substance misuse among non-clinical samples of youth and young adults (i.e., predisposition/vulnerability models), less is known about how it may relate to the maintenance of addictive behavior in clinical samples with higher rates of comorbid mental health conditions, physiological dependence, and associated adverse consequences of chronic use. Only a limited number of studies published in the past several years have attempted to validate the SURPS in various clinical populations of substance dependent individuals, and none so far have examined this instrument among MMT clients. In the next section, I will review each of these studies in turn.

Validation of the SURPS in Inpatient Substance Users

Schlauch et al. (2015) examined the psychometric properties of the SURPS among inpatient substance users. In their study, hopelessness was associated with higher alcohol use frequency; approach reactivity to opiate, cocaine, benzodiazepines, and cigarettes; and drinking to cope with depression, anxiety, enhancement, and social motives. Anxiety sensitivity was associated with higher frequency of cigarette use and lower frequency of stimulant use; was not associated with approach motivation to substance use cues; and was associated with drinking to cope with depression and anxiety and with enhancement motives. Impulsivity was associated with stimulant, opioid, and cannabis use frequency; approach motivation to cocaine, benzodiazepine, and cigarette cues; and non-specific drinking motives. Finally, sensation seeking was associated with alcohol, opioid, and benzodiazepine use frequency; approach motivation to alcohol and cannabis cues; and enhancement and social drinking motives. Although the SURPS showed good psychometric properties and good construct validity through many theoretically relevant associations, their work showed that motives for use among a clinical population are more difficult to differentiate and that the specificity of the SURPS may not hold as reliably as with non-dependent populations. For example, they suggested that hopelessness may not represent a specific pathway to substances with analgesic effects, but instead be associated with substance use more broadly and that it may be measuring depression rather than trait-like personality dimensions in a sample with high rates of comorbidity between depression and substance abuse (Schlauch et al., 2015).

Validation of the SURPS in Incarcerated Offenders

Hopley and Brunelle (2016) validated the SURPS personality model in a male offender sample using latent class cluster analysis. They demonstrated a three-cluster solution

characterized by differential personality levels, comorbid psychopathology, and SUDs. In this forensic sample, individuals higher in sensation seeking and lower in anxiety sensitivity were more likely to be engaged in substance use infractions.

Validation of the SURPS in community-recruited substance dependent individuals

Several studies in recent years have investigated the psychometric properties of translated versions of the SURPS in community recruited substance users in Bulgaria, China, and Lithuania. Long et al. (2018) investigated the factor structure of the Bulgarian SURPS and tested for group differences between substance dependent and non-dependent groups (which included mono-substance dependent heroin users, pure amphetamine users, polysubstance users, controls with no substance dependence history, and unaffected siblings of amphetamine and heroin users). They demonstrated that the Bulgarian version of the SURPS had adequate to good reliability, concurrent validity, and predictive validity. Specifically, significant elevations in the impulsivity and sensation seeking subscales relative to non-dependent controls predicted opiate, stimulant, and polysubstance dependence.

Chen et al. (2019) recruited 606 individuals who primarily used heroin or methamphetamines across two treatment centers in southwestern China and examined whether SURPS personality traits predicted substance use disorders using explanatory item response modeling. Their results suggest that higher levels of sensation seeking and hopelessness (for women only) was able to predict SUD levels.

Finally, Kaminskaite et al. (2020) recruited healthy volunteers and patients diagnosed with alcohol use disorder in Lithuania and examined the psychometric properties of the SURPS relative to hazardous alcohol use as measured by a score of 8 or higher on the Alcohol Use Disorders Identification Test (AUDIT). Relative to healthy controls, the alcohol use disorder

group had higher levels of hopelessness, anxiety sensitivity, and impulsivity for both males and females. Impulsivity and sensation seeking were both associated with hazardous alcohol use, and this effect was particularly strong among females.

Summary

Developing new tools for fighting the opioid epidemic, such as adapting personality-targeted psychosocial interventions to the MMT context, will be important for addressing some of the limitations of MMT or other forms of OAT and potentially enhancing treatment success. Developing new interventions for substance use requires a good understanding of how heterogeneity in substance use behaviour presents itself among MMT clients. This heterogeneity can be investigated through examination of different motivational processes (i.e., motives for use) and personality traits driving substance use behaviours. I have reviewed how four personality traits (AS, HOP, SS, and IMP) measured by the SURPS are unique risk factors predicting the onset and development of substance use and co-occurring psychological symptoms. Each of these traits is associated with specific patterns of substance use and motives for use, pharmacological sensitivity to drug effects, and sensitivity to either positive or negative reinforcement pathways. The SURPS has not yet been validated among MMT clients or any other sample currently undergoing OAT. The objective of this dissertation will be to address this gap.

Dissertation Aims

While the SURPS is only recently being validated in populations of individuals experiencing substance addiction, these personality traits and their correlates have not been investigated in an OAT setting, such as with MMT clients. My dissertation is a mixed-method

design combining both quantitative (hierarchical Bayesian models) and qualitative data analysis. Beyond the theoretical advancements in understanding how personality confers risk for the development and maintenance of addictive behaviour while in MMT, identifying the more proximal risk factors of substance use while in MMT as they relate to personality may provide valuable information for designing effective and brief treatments as an adjunct to pharmacological therapy (Amato et al., 2008; Connock et al., 2007; Dugosh et al., 2016). Given recommendations to develop and implement additional psychosocial interventions to address the opioid crisis (Dugosh et al., 2016), an adapted version of PreVenture may be able to have a positive impact as an adjunct treatment in MMT centers. This would require a better understanding of how personality risk is manifested in MMT clients and how motives for use relate to specific substances. My dissertation aims to bridge this knowledge gap by validating the SURPS and investigating how motives are related to substance use in an MMT setting, as well as identifying potential cognitive, affective, and behavioral treatment targets to be used for the development of future personality-targeted treatments.

Study 1

Entitled “Specificity of Personality Relationships to Particular Forms of Concurrent Substance Use Among Methadone Maintenance Therapy Clients”, Study 1 examined the factorial structure and concurrent validity of the SURPS on a sample of 138 MMT clients recruited across four sites in two Canadian provinces. At the time this project began in fall of 2015, Schlauch et al.'s (2015) study was the only published work having validated the SURPS in a clinical population of substance users. We hypothesized that the four-factor structure of the SURPS would hold, and that personality would be associated with specific recent use of various substances: hopelessness would be associated with recent use of opioids; anxiety sensitivity with

recent use of anxiolytics; sensation seeking with recent use of stimulants, alcohol, and cannabis; and impulsivity with recent use of stimulants and injection drug use. These hypotheses were derived based on prior validation studies of the SURPS and archival data from an older collaboration with an MMT clinic presented at a conference (Mahu et al., 2016).

Study 2

Study 2 was divided in two separate manuscripts (2A and 2B) and made use of the same quantitative data collected for Study 1. One of the novel contributions of Study 2 more generally was that we developed a brief and novel motives measure which could be applied to polysubstance use contexts, while also adding a withdrawal motive item. Study 2A is entitled “Different Drugs Come with Different Motives: Examining Motives for Substance Use Among Polysubstance Users Undergoing Methadone Maintenance Therapy (MMT)”. Study 2A largely investigated whether motives for use differ by substance. Additionally, I incorporated a novel analytical technique allowing me to examine whether motives for use have state vs trait characteristics, by examining the variance at the level of the individual (e.g., whether an enhancement-motivated individual will use multiple drugs for enhancement purposes; trait-like) or at the level of the drug (e.g., whether motive endorsement is context specific; state-like).

Although both manuscripts examine motives for use in MMT clients, Study 2B is an extension of the analyses performed in Study 2A to also include personality interactions. It is entitled “Motivations for Substance Use among Methadone Maintenance Therapy (MMT) Clients: Interactions between Personality and Substance Type”. It more specifically examines interactions between each of the four SURPS personality traits and six different drug categories, repeated across all seven motives. The purpose of Study 2B is to evaluate the relationship between personality and motives for use while examining six different drug categories,

extending prior research showing links between motives for use and SURPS personality traits in clinical populations (Schlauch et al., 2015).

Study 3

Entitled “The Four-Factor Personality Model and its Qualitative Correlates among Methadone Maintenance Therapy (MMT) Clients”, Study 3 employed a qualitative approach which examined individuals’ experience of their high-risk personality traits. Twenty MMT clients (a subset of the 138 from the previous manuscripts) scoring high on at least one of the SURPS traits were asked to tell a story about a time when their personality got them into trouble, and were guided to describe the cognitive, affective, physiological, and behavioral experience of their personality trait. Although the primary objective of this qualitative component was to collect information for creating and adapting future personality-targeted treatment manuals, it also provided a unique opportunity to examine how each trait maps on to MMT client’s personal experiences that would have relevance to a developing a psychosocial personality-targeted intervention for this population.

Outline

Each of the above manuscripts are presented in the upcoming chapters. Study 1 can be found in chapter 2, Study 2A in chapter 4, Study 2B in chapter 6, and Study 3 in chapter 8. Chapters 3, 5, and 7 provide transition between studies. Chapter 9 is an integrative discussion of all four manuscripts, including theoretical and clinical implications that emerged from my work.

CHAPTER 2. STUDY 1: SPECIFICITY OF PERSONALITY RELATIONSHIPS TO PARTICULAR FORMS OF CONCURRENT SUBSTANCE USE AMONG METHADONE MAINTENANCE THERAPY CLIENTS

This study is included in the manuscript prepared below. Under the supervision of Dr. Sherry Stewart, I developed the research questions and hypotheses, collected some of the data, prepared the dataset for analysis, conducted the analyses, and interpreted the study findings. I wrote the initial draft of the manuscript; then incorporated feedback from co-authors. This manuscript underwent peer-review, and I led the response to the one round of revisions. This manuscript was published in *Addictive Behaviors* in 2019. See Appendix A for copyright permissions from the publisher. The full reference is as follows:

Mahu, I. T., Conrod, P. J., Barrett, S. P., Sako, A., Swansburg, J., Lawrence, M., Laroque, F., Morin, J.-F., Chinneck, A., Nogueira-Arjona, R., & Stewart, S. H. (2019). Specificity of personality relationships to particular forms of concurrent substance use among methadone maintenance therapy clients. *Addictive Behaviors*, 98(March), 106056. <https://doi.org/10.1016/j.addbeh.2019.106056>

Abstract

Objective: A mainstay treatment for opioid addiction in North America is methadone maintenance therapy (MMT) – a form of opiate agonist therapy (OAT). While efficacious for treating opioid addiction, MMT fails to address the concurrent polysubstance use that is common among opioid dependent clients. Moreover, psychosocial approaches for addressing polysubstance use during MMT are lacking. Our study’s goals were to validate the use of the four-factor personality model of substance use vulnerability in MMT clients, and to demonstrate theoretically-relevant relationships of personality to concurrent substance use while receiving MMT. **Method:** Respondents included 138 daily-witnessed MMT clients (65.9% male, 79.7% Caucasian), mean age (SD) 40.18 (11.56), recruited across four Canadian MMT clinics. Bayesian confirmatory factor analysis was used to establish the structural validity of the four-factor personality model of substance use vulnerability (operationalized with the Substance Use Risk Profile Scale [SURPS]) in MMT clients. SURPS personality scores were then used as predictors for specific forms of recent (past 30-day) substance use. **Results:** Using a latent hierarchical model, hopelessness was associated with recent opioid use; anxiety sensitivity with recent tranquilizer use; and sensation seeking with recent alcohol, cannabis, and stimulant use. **Conclusion:** Personality is associated with substance use patterns and may be an appropriate target for intervention for those undergoing MMT to reduce opioid use, and potentially dangerous concurrent use of other drugs, while receiving methadone. **Keywords:** Methadone Maintenance Therapy, Hopelessness, Anxiety-Sensitivity, Sensation-Seeking, Impulsivity

Introduction

Prescription opioid misuse (i.e., using a prescribed opiate without a prescription, outside of its intended purposes, or in excessive quantities) has emerged as a major health concern in North America (Haydon et al., 2005). Opioid-related mortality rates have been steadily climbing; overdose rates have increased five-fold over the past 20 years (CDC, 2017). Treatment for opioid addiction in North America typically involves opioid agonist therapy (OAT) with methadone maintenance therapy (MMT) a common example.

MMT is an effective form of OAT for opioid use disorders (Bart, 2012). However, it is also recognized that MMT patients could also benefit from additional psychosocial treatments to facilitate adaptive coping strategies, prevent relapse, and reduce polysubstance use (Dugosh et al., 2016). Indeed, while MMT is effective for addressing opioid addiction, it does not adequately address the misuse of other substances (Darke et al., 1993; O. D. Taylor, 2015). Additionally, some MMT clients continue to administer opioids while receiving MMT (Kurdyak et al., 2012; Nosyk et al., 2014). MMT clients frequently have co-morbid substance use disorders, including alcohol, benzodiazepines, cocaine, and cannabis disorders (Brands et al., 2008; Darke & Ross, 1997; Kidorf et al., 2004; Rodríguez-Llera et al., 2006). MMT clients also frequently continue to administer drugs via injection, a particularly risky manner of drug administration (Bruneau et al., 2012).

Personality Model of Substance Use Vulnerability

One of the best-established personality models of addiction (e.g., Pihl & Peterson, 1995) posits that individual differences in substance use patterns are explained by differential sensitivity to the reinforcing effects of alcohol and drugs, based on

anatomically distinct motivational systems that are manifested as four lower-order personality dimensions (Comeau et al., 2001; Cooper, 1994; Cooper et al., 1995; Pihl & Peterson, 1995; Woicik et al., 2009). Elevations in these personality traits are theorised to predict risk for misusing specific substances, differential motivational profiles for substance use, differential sensitivity to the pharmacological effects of various drugs, and vulnerability to specific co-morbid psychological disorders (Castellanos-Ryan & Conrod, 2012).

These four personality traits can be measured with the Substance Use Risk Profile Scale (SURPS, Woicik et al., 2009) and include: sensation seeking (SS; novelty/pleasure seeking), impulsivity (IMP; disinhibited personality), anxiety-sensitivity (AS; fear of arousal) and hopelessness (HOP; depression-proneness). Individuals high in SS are said to be more sensitive to the rewarding, positively-reinforcing properties of substances (Brunelle et al., 2004). SS has been associated with stimulant (Chinneck et al., 2018; Low & Gendaszek, 2010), alcohol (Brunelle et al., 2004; Conrod, Pihl, et al., 2000; Schlauch et al., 2015; Woicik et al., 2009) and cannabis use (Hecimovic et al., 2014; Mahu et al., 2015). IMP is linked with poor response inhibition, deficits in planning, rapid decision making, and enhanced emotional reactivity (Krank et al., 2011; Woicik et al., 2009) and is associated with a wide range of substance use problems, including stimulant misuse, drinking problems, and polysubstance use, as well as anti-social behaviour (Castellanos-Ryan & Conrod, 2012). Individuals high in AS are motivated to use substances for regulation of negative affect and are said to be theoretically more sensitive to the anxiolytic properties of substances. They are therefore more likely to use drugs with anxiolytic effects, such as benzodiazepines (Chinneck et al., 2018). Lastly, individuals

high in HOP are said to be more likely to suffer from depressive symptoms and mood disorders and are more sensitive to punishment (Castellanos-Ryan & Conrod, 2012; Pihl & Peterson, 1995). They are theoretically more sensitive to the analgesic effects of the opioids, which are thought to be used to suppress emotional pain (Conrod, Pihl, et al., 2000). Individuals high in HOP are therefore more likely to use opioids for their psychic pain-numbing properties, a prediction supported in adolescents (Chinneck, Conrod, et al., 2018; Woicik et al., 2009), young adults (Chinneck et al., 2018), and community-recruited women substance users (Conrod, Pihl, et al., 2000).

Present Study

Most theoretical and empirical research using the four-factor personality model has focused on adolescents and emerging adults (Castellanos-Ryan & Conrod, 2012; Krank et al., 2011; Woicik et al., 2009). Less is known about whether and how these four personality traits may maintain substance use in adult clinical populations at a later stage of addiction. Only recently, two studies validated the SURPS among substance dependent individuals, but not among MMT clients (Long et al., 2018; Schlauch et al., 2015). MMT clients are a unique population of substance users in treatment for opioid addiction, who often present with high rates of polysubstance use (e.g., opioids, sedatives, stimulants), mental health difficulties (e.g. depression, anxiety), and numerous physical health concerns and stressors (e.g. health consequences of injection drug use, chronic pain; Glenn et al., 2016; W. L. White et al., 2014). Therefore, studying the psychometric properties of the SURPS within this population is of great theoretical (i.e., investigating personality effects in maintenance of addiction) and clinical interest (i.e., increasing the generalizability of the SURPS). Thus, the goals of this study were to test the structural

validity of the SURPS in this population and to demonstrate construct validity by investigating relationships between SURPS personality traits and concurrent substance use among MMT clients.

First, this study sought to structurally-validate the SURPS personality measure in an MMT population using confirmatory factor analysis (CFA). It was hypothesized that the expected four-factor structure model observed in other populations (Long et al., 2018; Schlauch et al., 2015; Woicik et al., 2009) would be replicated within the MMT population. The theorized four-factor model specified by Pihl and Peterson (1995) was also compared to a two-factor model (internalizing vs. externalizing traits) given the historical acceptance of two-factor addiction-prone typologies (Babor et al., 1992; Babor & Caetano, 2006; Leyton & Stewart, 2014).

Second, this study used SURPS personality scores and investigated their associations with specific types of recent substance use in MMT clients to establish construct validity. We tested these hypotheses in two models; one using the SURPS summed-scores (e.g., as the SURPS would be used in most clinical and research settings; Blanchard et al., 2020), and a second hierarchical model that estimated latent personality scores from item content (e.g., a more sensitive model). In line with Pihl and Peterson's (1995) theory and previous literature (Conrod et al., 2000; Krank et al., 2011; Schlauch et al., 2015; Woicik et al., 2009), we hypothesized that HOP would be associated with recent use of opioids (H1); AS would be associated with recent use of anxiolytics (H2); SS would be associated with recent use of stimulants (H3), alcohol (H4), and cannabis (H5); and IMP would be associated with stimulant use (H6) and injection drug use (H7).

If the SURPS is an accurate clinical instrument among MMT clients, we would expect to replicate the above hypotheses across both the “summed” and latent model (H8).

Materials and Methods

Participants

Participants (n=138) were recruited from four MMT clinics located in two Canadian cities. Because of potential differences between sites (e.g., differences in culture, language, and/or treatment philosophy), we controlled methadone clinic in all analyses. Inclusion criteria included being a daily witnessed MMT client at one of the four participating clinics for at least the past 30 days, as we were interested in recent concurrent substance use while undergoing MMT. Participant demographics are reported in Table 1.

Procedure

Participants completed a series of self-report questionnaires in a private room at each individual clinic. This study was conducted in accordance with ethical approval obtained from the relevant research ethics boards at each site. We collected demographic information and administered the following questionnaires:

Substance Use Risk Profile Scale (SURPS; Woicik et al., 2009). The SURPS, a 23-item self-report questionnaire, measures personality traits across four domains: IMP (5-items, e.g. *“I often don’t think things through before I speak”*); SS (6-items, e.g. *“I like doing things that frighten me a little”*); HOP (7-items, e.g. *“I feel that I’m a failure”*); and AS (5-items, e.g. *“It’s frightening to feel dizzy or faint”*). Participants responded using a 4-point Likert scale (1 *strongly disagree* to 4 *strongly agree*). The

SURPS demonstrates good concurrent, predictive, and incremental validity in differentiating between reinforcement-specific patterns of substance use, and good test-retest reliability, among youth and adults (Castellanos-Ryan, O'Leary-Barrett, Sully, & Conrod, 2013; Krank et al., 2011; Woicik et al., 2009).

Substance Use Questionnaire (S. P. Barrett et al., 2005). Lifetime use, past 12-month use, and past 30 days use were collected for alcohol, cannabis, amphetamines, hallucinogens, opiates, cocaine, and a wide range of prescription drugs. Drug types were combined to create the following drug categories for analyses: stimulants (powder cocaine, crack cocaine, prescription stimulants, and other street-stimulants); opioids (i.e., prescription opioids and heroin); and tranquilizers (i.e., prescription tranquilizers and Seroquel). Alcohol and cannabis were each examined alone. Self-reported substance use has been shown to be relatively accurate among MMT clients (Darke, 1998; Hilario et al., 2015; Sherman & Bigelow, 1992). To maximize the validity of our self-report data, we posed questions in an open-ended format and assured participants of confidentiality and that there would be no negative consequences to honest reporting. A sham-drug item was also included to screen for over-reporting (i.e., “Have you used kiaran in the past 30-days?”); however, it was not endorsed. Finally, we reduced retrospective reporting bias by focusing our analyses on recent (past 30-day) substance use.

Statistical Analyses

We used a Bayesian approach to data analysis. We used skeptical, weakly-informed priors for this analysis by scaling the data to have a mean of zero and standard deviation of one and using priors for all effects that are normally distributed with a mean of zero and a standard deviation of one. With this specification, we convey a peak prior

belief in zero effect, but maintain reasonable belief for effects of either sign and with a magnitude equal to the amount of noise observed in the data. Such beliefs reflect more skeptical beliefs (i.e. greater relative belief in zero effect) than those implicit in the typical frequentist analysis, which equates to beliefs that are uniform from negative to positive infinity. Therefore, this is a more conservative approach whereby the posterior distribution is primarily driven by the data and is appropriate to use when uncertain of the variability of different parameters (Van de Schoot et al., 2014). We used a parameter estimation approach. Models were implemented using the Stan modeling language (Stan Development Team, 2018) in R. Markov Chain Monte Carlo (MCMC) sampling was used, with 4-chains, each consisting of 20,000 iterations and 10,000 warm-up draws per chain. Each chain was permitted to independently converge with random starting points.

We used confirmatory factor analysis to validate the expected 4-factor structure of the SURPS, as compared to a 2-factor structure. The relevant SURPS items were modeled as ordinal variables and converged on four hypothesized latent factors representing HOP, AS, IMP, and SS, respectively. The Stan code for this model is included in the online materials. Although traditional fit indices are not available for Bayesian statistics, we evaluated the predictive accuracy of the CFA by inspecting model convergence, diagnostic statistics, and visual posterior predictive checks (PPC).

SURPS personality scores were then regressed on six binomial substance use outcomes (i.e., past-30 day use of opioids, stimulants, tranquilizers, alcohol, marijuana, and injection drug use), while co-varying for current methadone dosage, site, and gender (Bawor et al., 2015). This was done in two ways. First, we tested a model testing the SURPS performing “out-of-the-box”, by using the summed scales as described by

Woicik et al. (2009). Second, we tested a hierarchical latent model with an ordinal-link, where each SURPS item was regressed onto the hypothesized latent personality factor, and these factors were in turn regressed on the different substance use outcomes. The advantage of this second approach is that it incorporates all the available information (e.g., conserving individual item weights and posterior distributions) while accounting for dependencies between ratings from the same person and the same item (Liddell & Kruschke, 2018). We present both results here, as the former model represents how the SURPS is used in clinical practice and most research contexts, whereas the latter model more accurately estimates the four latent factors.

Results

The substance use history data of our sample is reported in Table 2. Table 3 reports means, standard deviations, internal consistency, and intercorrelations for the SURPS scales in our sample, showing adequate-to-good internal consistency and specificity for each scale. Table 4 reports diagnostics and the posterior draws for the 4-factor and the 2-factor model. All pareto-k values were within acceptable ranges (e.g., $k < 0.7$; Suppl Figure 1). A visual posterior predictive check confirmed that the CFA fit the data well (Suppl. Figure 2). Model comparison using leave-one-out cross-validation (LOO) confirms superior fit for the 4-factor model (Vehtari et al., 2015).

Table 5 reports on the relationship between personality scores and recent substance use. Consistent with our hypothesis, higher levels of HOP were associated with higher rates of recent opiate use (H1). Moreover, higher levels of AS were associated with higher rates of recent tranquilizer use (H2). Additionally, higher levels of SS were associated with higher rates of recent stimulant (H3), alcohol (H4) and cannabis use (H5).

Contrary to our hypotheses, levels of IMP were not associated with higher rates of use of any specific substance (H6). We found partial support for higher levels of IMP being associated with higher rates of recent injection drug use (H7), and unexpectedly, higher levels of HOP predicting tranquilizer use – but only in the model using the traditional SURPS scoring. The SURPS appears to perform well when used “out-of-the-box” among MMT clients, as the latent model replicated most of the hypothesized effects.

Discussion

The SURPS has been extensively validated in youth and young adult populations (Castellanos-Ryan et al., 2013; Krank et al., 2011; Woicik et al., 2009) and has been used to measure risk for developing substance use problems. Research on this model led to the development of effective personality-targeted substance use interventions (see Conrod, 2016). The goal of the present study was to investigate whether the SURPS personality factors are associated with recent use of specific drugs among an MMT sample, which has the potential to inform future personality-targeted treatment in this population. This study provides emerging evidence that the SURPS displays structural and construct validity and adequate-to-good internal consistency among MMT clients. Although limited by a cross-sectional survey design, we demonstrated theoretically-relevant personality—substance use relationships in a sample at a later stage of addiction, which provides justification for developing and evaluating personality-targeted interventions in this population using prospective designs.

Personality correlates of substance use among MMT clients

Hopelessness

Consistent with our hypotheses, HOP was associated with recent opioid use. HOP has long been suggested to be associated with the use of substances like opioids that dampen negative affect and punishment sensitivity (Gray, 1982; Pihl & Peterson, 1995). Other studies using the SURPS (e.g., Chinneck, Thompson, et al., 2018; Conrod, Pihl et al., 2000) have also highlighted this vulnerability to opioids in high HOP adults. Unexpectedly, HOP was also a predictor of recent tranquilizer use in this sample, but only when measuring HOP using summed scores. This suggests that this effect may result from measurement error when using summed scores. It is also possible that MMT clients who are high in HOP may be more likely to use tranquilizer drugs to enhance the effects of opioids, including methadone (e.g., Jones et al., 2012); however we caution that replication would be needed to establish the validity of this finding. Overall, these results would suggest that MMT clients high in HOP may benefit from cognitive-behavioral strategies that address maladaptive depressogenic thinking as well as depressive symptoms (Conrod et al., 2006), to reduce their use of opioids while taking methadone (Jones et al., 2012).

Anxiety-Sensitivity

Consistent with our hypothesis, AS was associated with recent tranquilizer use. Individuals high in AS are theoretically and empirically more sensitive to the anxiolytic effects of drugs like benzodiazepines (Conrod, Pihl, et al., 2000; Hearon et al., 2011; Stewart & Kushner, 2001). It has long been suggested that opioids and benzodiazepines have interacting pharmacokinetic effects, which may explain the historically high co-use of these drugs in opioid treatment programs (J. D. Jones et al., 2012; Stitzer et al., 1981). Moreover, this combination is particularly dangerous, as co-use of benzodiazepines and

opioids (including methadone) confers greater overdose risk (Gudin et al., 2013; J. M. White & Irvine, 1999). Converging lines of evidence suggest that benzodiazepine-misusing MMT clients may present with more complicated clinical profiles, higher rates of psychopathology, and higher rates of polysubstance use (Brands et al., 2008; Darke et al., 1993; Darke & Ross, 1997; Fulton et al., 2011). These results highlight that high AS MMT clients could benefit from cognitive and behavioral skills training in managing anxiety symptoms to reduce their risky use of tranquilizers while on methadone.

Sensation-Seeking

Our findings indicate that SS was related to recent stimulant, alcohol, and cannabis use among MMT clients. Co-use of alcohol and methadone has been found to negatively impact cognitive performance and daily functioning (Kleykamp et al., 2015) and increase overdose risk (Webster et al., 2011). While research on the effects of cannabis use while on MMT is mixed (e.g., Epstein & Preston, 2003; Mayet et al., 2015), some studies caution that cannabis use is a predictor of poorer MMT responses (Franklyn, Eibl, Gauthier, & Marsh, 2017; Zielinski et al., 2017). The latter also holds true for stimulant (e.g., cocaine) effects on MMT outcomes (Greenfield et al., 1996), with stimulant co-use also being associated with greater HIV risk, polydrug use, criminal behaviour, and psychological disturbances (Grella et al., 1995, 1997). High SS clients in MMT programs may therefore benefit from cognitive-behavioral strategies to manage their need for stimulation and excitement without resorting to use of alcohol, cannabis, or stimulant drugs.

Impulsivity

IMP has been linked with stimulant misuse in previous research given the difficulty of impulsive individuals to inhibit behaviours with immediate rewards (Brunelle et al., 2004; Conrod, Pihl et al., 2000; Schlauch et al., 2015; Woicik et al., 2009). Nonetheless, contrary to our hypotheses, we found no relationships between IMP and stimulant use. Long term participation in MMT may attenuate the relationship between IMP and stimulant use given methadone's sedative effects and our focus on substance use *during* MMT. It may also be possible that there is a self-selection into MMT programs, with more impulsive individuals not being able to cope with the structured demands of the programs and thus dropping out early (prior to 30 days).

We found partial support for injection drug use being associated with higher scores on IMP. This effect did not replicate in the hierarchical latent model, which may reflect potential measurement error when using summed scores for measuring IMP among MMT clients. These findings warrant additional inquiry and replication in future studies, particularly given risks associated with injection drug use (Bruneau et al., 2012; Degenhardt et al., 2006, 2013; Fischer et al., 2014).

Limitations

Certain interpretative caveats need to be acknowledged. Due to the preliminary nature of this work, one major limitation of this study is the cross-sectional design. We are therefore limited to correlational data and thus cannot make causal inferences. While it is possible that personality impacted substance use, it is also possible that substance use may have had effects on personality. Indeed, chronic substance use has been shown to increase impulsivity (Crews & Boettiger, 2009; Mendez et al., 2010; Setlow et al., 2009), anxiety-like experiences (Koob & Volkow, 2010), depressive-like states (J. M. White,

2004) and sensation seeking (Ersche et al., 2010; Gjedde et al., 2010). However, evidence from prospective studies using the four-factor personality model suggests that maladaptive personality traits develop before substance use initiation and predict escalations in substance use over time, and that targeting these traits in intervention results in reductions in substance use (Conrod, 2016; Conrod & Nikolaou, 2016). Nevertheless, future studies should consider extending these results using longitudinal and intervention studies with MMT clients.

Conclusions

Evidence from this study suggests that personality remains important in the maintenance of substance use among clients receiving methadone for the treatment of opiate addiction. Personality-matched treatments (e.g., Conrod, 2016) administered as adjuncts to MMT should be considered and developed, particularly given the high rates of polysubstance use, risky manner of use (e.g., injection), dangerous drug combinations (e.g., opioids plus benzodiazepines), and mental health difficulties commonly disclosed by MMT clients. In the context of the current opioid epidemic, personality-matched treatments that target personality-specific maladaptive coping skills among these clients with the goal of reducing substance use may prove to be an effective, low-cost, and valuable service as an adjunct to MMT (Stewart et al., 2018). Future research should investigate the adaptation, feasibility, and effectiveness of such a psychotherapeutic intervention in the MMT context.

Tables

Study 1 Table 1. Participant Demographics (N = 138).

Characteristic	Frequency/Descriptives
Methadone Clinic Location	
Direction 180	34.1% (n = 47)
Nova Scotia Health Authority – Central District OST Clinic	23.2% (n = 32)
The Addiction Medicine Outpatient Clinic of the CHUM	21.7% (n = 30)
Programme CRAN du CIUSSS Centre-Sud-de l'île- de - Montréal	21.0% (n = 29)
Gender	
Male	65.9% (n = 91)
Female	34.1% (n = 47)
Age (years) – Mean (SD) [range]	40.18 (11.56) [21-71]
Occupation	
Unemployed	29.0% (n = 40)
Social Assistance	2.9% (n = 4)
Retired	3.6% (n = 5)
Student	2.2% (n = 3)
Employed	50% (n = 69)
Disabled	8.0% (n = 11)
Undisclosed	4.3% (n = 6)
Yearly Income (Canadian dollars)	
\$10,000 or less	39.9% (n = 55)
\$10,001 – \$20,000	34.1% (n = 47)
\$20,001 - \$30,000	10.8% (n = 15)
\$30,001 and above	13.0% (n = 18)
Undisclosed	2.2% (n = 3)
Education (highest degree completed)	
Junior high-school or less	18.8% (n = 26)
High-school	42.8% (n = 59)
Trade school	10.1% (n = 14)
Community school	1.4% (n = 2)
Some university/college	10.9% (n = 15)
University/college	13.0% (n = 18)
Other	2.9% (n = 4)
Ethnicity/Race	
White/Caucasian	79.7% (n = 110)
Black, Afro-Canadian, Carribbean-Canadian	2.2% (n = 3)
Aboriginal/First Nations	10.9% (n = 15)
Other	7.2% (n = 10)
Living arrangements	
Renting	63.0% (n = 87)
Home-owner	6.5% (n = 9)
Living with friends or family (not paying rent)	8.7% (n = 12)
Living in community shelter/transitional housing	12.3% (n = 17)
Living on streets	2.2% (n = 3)
Other	7.2% (n = 10)
Relationship Status	
Single (never married)	55.8% (n = 77)
Married/Cohabiting	13.8% (n = 19)
Separated/Divorced	15.9% (n = 22)
Widowed	2.9% (n = 4)
Common Law	11.6% (n = 16)

Mean methadone dose (SD)	78.64 mg (40.15 mg)
Length of treatment prior to study, in days; Median (IQR)	542.5 (146.25, 2098.75)

Note. CHUM = Centre Hospitalier de l'Université de Montréal.

Study 1 Table 2. Participant Substance Use History (N = 138).

Substance	Lifetime Use (%)	Past-12 Month Use (%)	Past-30 Days Use (%)
Alcohol	98.6	55.8	34.8
Cannabis	95.7	66.5	55.1
Hallucinogens	82.6	14.5	4.3
Ecstasy	70.3	9.4	2.9
Powdered Cocaine	89.9	39.1	17.4
Crack Cocaine	73.9	36.2	22.5
Other Stimulants	65.9	18.8	5.8
Rx Stimulants	60.9	29.7	13.8
Heroin	55.8	20.3	8.0
Rx Opioids	94.2	51.4	23.2
Rx Tranquilizers	84.8	57.2	42.0
Seroquel	70.3	32.6	19.6
Recent Injection ^a			27.5
Any Stimulant ^b			41.3
Any Opioid ^c			29.0
Any Tranquilizer ^d			54.3

Note: ^aInjection drug use consisted of any past-30-day reports of using injection as a delivery method for any of the drugs on the list. ^bPercentage of participants who reported using Powdered Cocaine, Crack Cocaine, Other Stimulants and/or Rx Stimulants. ^cPercentage of participants who reported using Rx Opioids and/or Heroin. ^dPercentage of participants who reported using Rx Tranquilizers and/or Seroquel.

Study 1 Table 3. Substance Use Risk Profile Scale Mean Scores, Internal Consistency, and Intercorrelations between personality factors. (n = 138)

	Means	SD	α	HOP [95% CI]	AS [95% CI]	IMP [95% CI]	SS [95% CI]
HOP	15.19	3.75	.79	1.00	0.04 [-0.19 , 0.25]	0.08 [-0.15, 0.31]	-0.05 [-0.28 , 0.20]
AS	12.83	3.11	.75		1.00	0.46 [0.24 , 0.66]	-0.07 [-0.33 , 0.19]
IMP	12.50	2.95	.72			1.00	0.33 [0.07 , 0.56]
SS	16.44	3.31	.63				1.00

Note: HOP = Hopelessness. AS = Anxiety-Sensitivity. IMP = Impulsivity. SS = Sensation-Seeking. SD = Standard Deviation. α = Chronbach's alpha. CI = Credible Interval (Bayesian).

Study 1 Table 4. Bayesian Confirmatory-Factor Analysis of the Substance Use Risk Profile Scale

	Item	4-Factor Model			2-Factor Model		
		Mean Beta Estimate	SD	95% CI	Mean Beta Estimate	SD	95% CI
HOP	1	1.87	0.50	1.06, 3.02	2.36	0.67	1.31, 3.89
	4	2.30	0.60	1.33, 3.67	2.92	0.80	1.65, 4.70
	7	2.56	0.68	1.46, 4.14	2.94	0.87	1.61, 4.94
	13	1.40	0.41	0.72, 2.33	1.65	0.52	0.81, 2.82
	17	1.05	0.35	0.47, 1.85	1.50	0.48	0.72, 2.59
	20	1.91	0.52	1.08, 3.08	2.25	0.65	1.19, 3.73
	23	2.70	0.71	1.57, 4.34	3.01	0.88	1.66, 5.01
AS	8	1.89	0.53	1.04, 3.08	0.22	0.18	0.01, 0.65
	10	1.94	0.55	1.06, 3.19	0.54	0.30	0.05, 1.21
	14	1.85	0.53	1.00, 3.07	0.47	0.29	0.03, 1.14
	18	1.71	0.50	0.90, 2.84	0.35	0.24	0.02, 0.92
	21	1.82	0.52	0.98, 3.00	0.38	0.25	0.02, 0.99
IMP	2	1.54	0.48	0.77, 2.64	1.63	0.56	0.73, 2.92
	5	2.36	0.65	1.31, 3.87	2.14	0.69	1.02, 3.74
	11	1.96	0.56	1.05, 3.24	1.91	0.64	0.91, 3.37
	15	1.42	0.43	0.73, 2.38	1.64	0.55	0.78, 2.94
	22	1.27	0.39	0.62, 2.16	1.35	0.48	0.57, 2.44
SS	3	1.22	0.44	0.53, 2.23	0.69	0.35	0.10, 1.46
	6	0.70	0.31	0.17, 1.40	0.62	0.33	0.08, 1.35
	9	1.74	0.53	0.88, 2.96	1.16	0.44	0.42, 2.19
	12	1.41	0.50	0.62, 2.56	0.89	0.39	0.23, 1.77
	16	1.60	0.51	0.79, 2.79	1.90	0.59	0.94, 3.22
	19	0.95	0.37	0.34, 1.79	0.73	0.36	0.14, 1.58
Model Fit Indices							
	LOOIC	6962.7	66.6 (SE)		7276.9	63.4 (SE)	
	ELPD difference	-157.1	17.1 (SE)				
	Parreto-K (k < 0.5)	99.2%			99.8%		
	(k = 0.5 to 0.7)	0.8%			0.2%		
	Divergent Iterations	0%			0%		
	Saturated TD	0%			0%		
	E-BFMI warning	none			none		

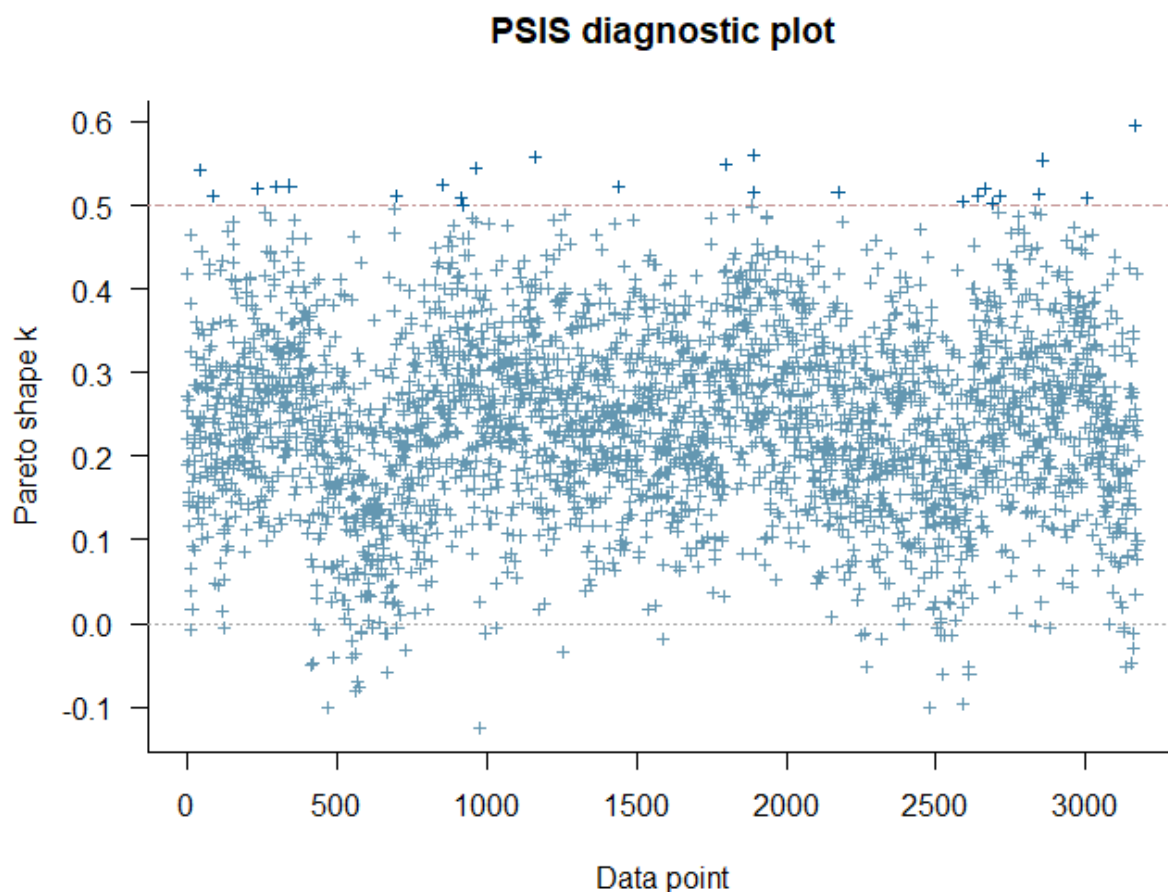
Note: Hopelessness (HOP) = Items 1, 4, 7, 13, 17, 20, 23 (all but item 17 are reverse scored). Anxiety-Sensitivity (AS) = Items 8, 10, 14, 18, 21. Impulsivity (IMP) = Items 2, 5, 11, 15, 22. Sensation-Seeking (SS) = Items 3, 6, 9, 12, 16, 19. LOOIC = Leave-One-Out Information Criterion (smaller is better). ELPD = Expected Log Pointwise Predictive Density (LOO model comparison that measures the difference in predictive accuracy between Model 1 and Model 2; a negative value favors Model 1). LOO model comparison was conducted on models with fewer iterations due to the original number of iterations overloading computational limitations. Parreto-K = Parreto Smoothed Importance Sampling diagnostic (k < 0.5 = good, k < 0.5 - 0.7 = ok, k > 0.7 indicate misfit). TD = Treedepth (saturated treedepth suggests inefficient sampling). E-BFMI = Estimated Bayesian Fraction of Missing Information (if present, suggests that the chains did not fully explore the posterior distribution). SD = Standard Deviation. SE = Standard Error. CI = Credible Interval (Bayesian). The 2-Factor model combines the internalizing traits (Hopelessness and Anxiety-Sensitivity) and the externalizing traits (Impulsivity and Sensation-Seeking).

Study 1 Table 5. Personality and Substance Use Outcomes

Personality Trait	Model 1: Traditional SURPS (e.g. summed scores)			Model 2: SURPS Hierarchical Latent Model with Ordinal Link		
	Mean Beta	SD	95% CI	Mean Beta	SD	95% CI
Opiates						
HOP	0.60	0.23	0.15, 1.07*	1.23	0.54	0.35, 2.47*
AS	0.20	0.23	-0.25, 0.67	0.65	0.62	-0.46, 2.00
IMP	0.21	0.23	-0.23, 0.67	0.52	0.67	-0.64, 2.01
SS	-0.11	0.23	-0.56, 0.33	0.11	0.53	-0.94, 1.16
Tranquilizers						
HOP	0.44	0.22	0.02, 0.89*	0.81	0.50	-0.02, 1.94
AS	0.67	0.24	0.21, 1.16*	1.70	0.83	0.45, 3.61*
IMP	-0.07	0.21	-0.49, 0.35	-0.47	0.70	-2.04, 0.69
SS	0.11	0.21	-0.31, 0.53	0.60	0.58	-0.36, 1.88
Alcohol						
HOP	-0.30	0.22	-0.75, 0.13	-0.41	0.41	-1.29, 0.35
AS	0.02	0.23	-0.43, 0.48	0.29	0.53	-0.67, 1.45
IMP	-0.18	0.22	-0.61, 0.25	-0.77	0.65	-2.28, 0.27
SS	0.49	0.23	0.05, 0.95*	1.48	0.72	0.36, 3.16*
Cannabis						
HOP	0.24	0.20	-0.14, 0.63	0.41	0.38	-0.26, 1.23
AS	0.18	0.21	-0.23, 0.60	0.58	0.55	-0.34, 1.81
IMP	-0.16	0.21	-0.57, 0.25	-0.66	0.63	-2.09, 0.36
SS	0.45	0.20	0.06, 0.87*	1.40	0.65	1.31, 0.39*
Stimulants						
HOP	0.07	0.21	-0.34, 0.48	0.21	0.39	-0.54, 1.02
AS	0.24	0.22	-0.19, 0.69	0.71	0.58	-0.32, 1.96
IMP	0.35	0.22	-0.08, 0.78	0.36	0.60	-0.76, 1.65
SS	0.43	0.21	0.00, 0.88*	1.46	0.74	0.31, 3.18*
Injection						
HOP	0.13	0.22	-0.31, 0.56	0.44	0.42	-0.34, 1.34
AS	0.33	0.24	-0.13, 0.81	0.67	0.63	-0.46, 2.02
IMP	0.51	0.24	0.05, 0.99*	0.93	0.77	-0.30, 2.70
SS	0.38	0.24	-0.09, 0.86	1.02	0.67	-0.10, 2.52

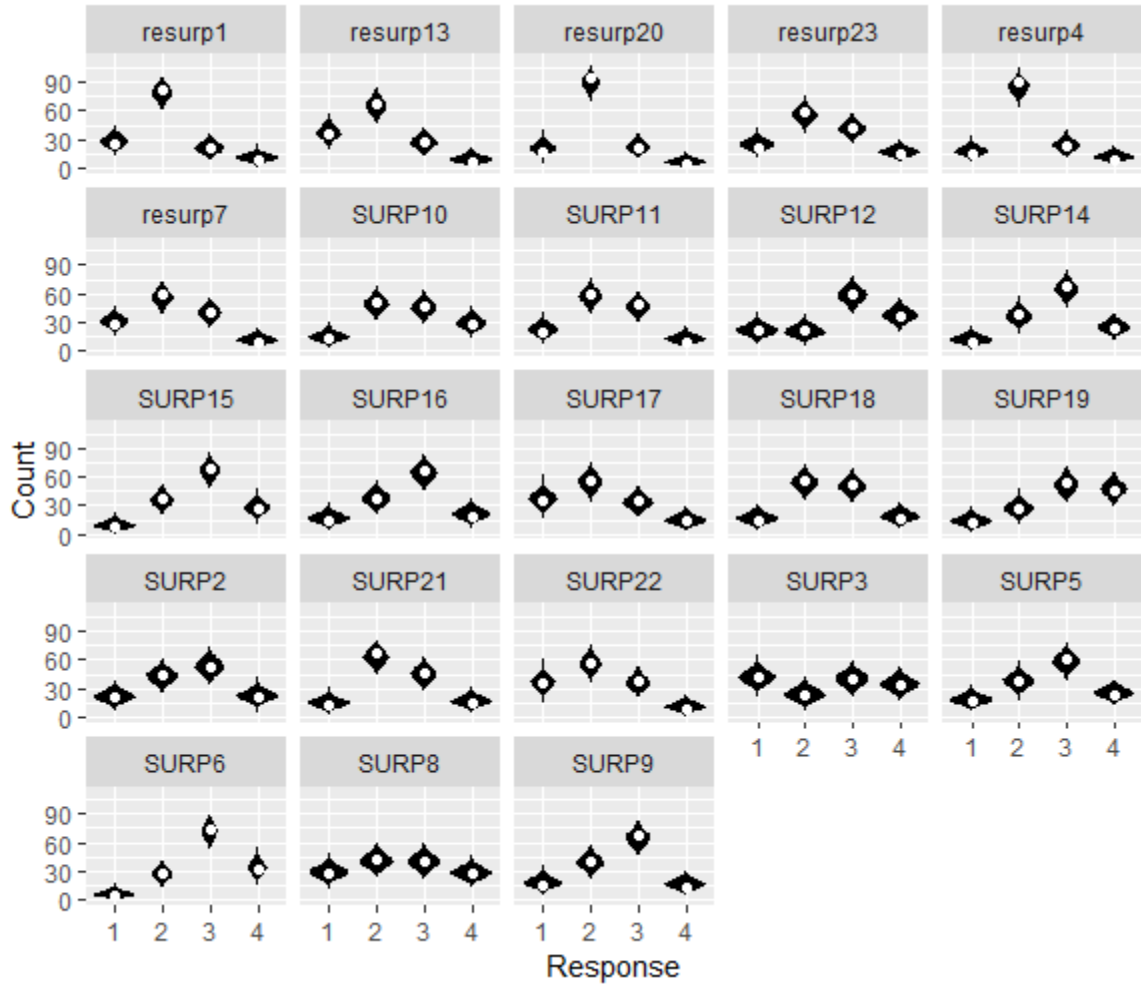
Note: SURPS = Substance Use Risk Profile Scale, HOP = Hopelessness. AS = Anxiety-Sensitivity. IMP = Impulsivity. SS = Sensation-Seeking. Mean betas reflect log-odd values; reflecting the change in log-odds caused by a 1 SD increase in the latent factor. *= 0 is a relatively non-credible value for the influence of the personality factor on substance use. SD = Standard Deviation. CI = Credible Interval (Bayesian). Model 1 is a model where the summed personality scores from the SURPS items were regressed on the substance use outcomes (e.g., typical clinical use). Model 2 is a hierarchical model where each SURP item is modeled as an ordinal variable and is individually regressed on the latent personality factor (preserving individual item weights), which is then regressed on the substance use outcome (e.g., a more accurate model).

Study 1 Supplementary Figure 1: Leave One Out Pareto Smoothed Importance Sampling Diagnostic (LOO-PSIS) Plot



Note: PSIS = Pareto Smoothed Importance Sampling. This shows an index of all observations and their respective Pareto shape k parameter estimates. Pareto k is a measure of influence of an observation, and highly influential observations have high k values. Very high k values indicate model misspecification, outliers or mistakes. This plot shows the reliability and approximate convergence rate of the PSIS-based estimates. The Pareto k also estimates how far an individual leave-one-out distribution is from the full distribution, and values above 0.7 introduce bias. Values of $k < 0.5$ are considered good; $k < 0.7$ is acceptable.

Study 1 Supplementary Figure 2. Graphical Posterior Predictive Check for the 23-SURPS items



Note: SURPS = Substance Use Risk Profile Scale. Each visualization shows individual SURPS items, with the 4 ordinal response categories on the x-axis, and frequencies (counts) on the y-axis. The items labelled “resurp” are reverse coded items; the numerals above each visualisation identify which SURPS item displayed (e.g., SURP16 = item 16 on the SURPS). This figure plots the observed data (white dots) against the generated posterior predictions from the model (black violin graphs). The overlap between dots and violin plots suggests the model simulated data very similar to the observed data, which is an indication of good fit in the Bayesian framework.

CHAPTER 3. TRANSITION FROM STUDY 1 TO 2

Motives by Substance

Study 1 results demonstrate that personality appears to be related to specific forms of substance misuse among MMT clients; however potential mechanisms through which this may occur are yet unclear. The theory underlying the Four Factor Personality Vulnerability model (Castellanos-Ryan & Conrod, 2012; Conrod, Pihl, et al., 2000; Pihl & Peterson, 1995) purports that differential sensitivity within anatomical/neurological brain structures, expressed phenotypically as personality traits, are casually related to specific substance use motives. These motives in turn mediate the relationship between personality and substance misuse. However, most of the motivational literature has focused more narrowly on drinking motives, especially among non-clinical populations. In comparison, relatively little is known about substance use motives in clinical populations that engage in polysubstance use, and almost no studies have investigated the expression of substance use motives in a within-subject design which would allow one to parse the variance in motive endorsement between different drug categories within the same sample. In this chapter, I will briefly review the pharmacological and psychological effects of each of the six drug classes, as well as how motives for these substances have typically been measured.

Alcohol and Drinking Motives

Alcohol is one of the most widely used and abused drugs in human history, with wide ranging dose-dependent effects. When consumed, in order of increasing dose,

alcohol can reduce anxiety, enhance mood, sedate, slow reaction time, impair motor coordination, cloud judgement, induce nausea and vomiting, and act as an anaesthetic (Wallner & Olsen, 2008). While light alcohol use has been linked to some beneficial health effects (e.g., cardiovascular health), heavy alcohol use has been related to numerous health problems (e.g., gastrointestinal, brain abnormalities, cognitive function, addiction) (Goudriaan & Sher, 2012). Withdrawal symptoms from alcohol dependence can be serious and include seizures, tremors, auditory and tactile disturbances, and delirium. These symptoms typically peak 72 hours after last use of alcohol, and can be treated with benzodiazepines, anticonvulsants, and adjunctive agents (Kosten & O'Connor, 2003).

Given the importance of alcohol in our society, it is not surprising that the motivational literature has focused extensively on drinking motives. As reviewed in Chapter 1, four broad motive categories were identified in the initial Drinking Motives Questionnaire (DMQ-R; Cooper, 1994): enhancement, social, coping and conformity motives. Coping motives were later revised to differentiate between coping with depression and coping with anxiety given their unique contributions to drinking outcomes (V. V. Grant et al., 2007).

Tobacco/Nicotine and Smoking Motives

Cigarette smoking is a chronic relapsing disorder that is a leading cause of death and morbidity. Not only does it disproportionately affect individuals with lower education, lower income, minority status, and higher psychiatric comorbidities, nicotine use disorder is also associated with high relapse rates and low treatment success (Rigotti et al., 2022). Relative to other substances reviewed in this chapter, smoking tobacco (i.e., defined here

as cigarettes containing nicotine) does not produce a disabling state of intoxication. However, that is not to say that nicotine does not have psychoactive effects, as nicotine is a stimulant known to improve working memory, enhance concentration, and suppresses appetite. Tobacco is also extremely addictive, and discontinuation when dependent can cause rapid onset (i.e., within 4-24 hours) of withdrawal symptoms (McLaughlin et al., 2015). Nicotine withdrawal tends to peak during the 3rd day of cessation and slowly tapers off over the following 3-4 weeks. These withdrawal symptoms will have affective, somatic, and cognitive consequences, which can include irritability, anger, frustration, anxiety, depressed mood, difficulty concentrating, impaired memory, increased appetite, insomnia, restlessness, constipation, dizziness, nightmares, nausea, and sore throat.

Because of the unique pharmacological properties of nicotine, the motivational literature on tobacco/smoking has diverged somewhat from the four categories of motives outlined by Cooper (1994). Although some similarities remain, motives for smoking have typically been dominated by self-focused motives and also include habitual/automatic motives (e.g., smoking to reduce craving and withdrawal symptoms), implying that tobacco use is under less intentional control than most other substances (Cooper et al., 2016). Indeed, cigarette smoking is associated with physical dependence on nicotine and is considered a learned behaviour (Rigotti et al., 2022).

Of note, smoking rates appear to be very high among MMT clients relative to the general population in North America. It has been suggested that nicotine can make methadone or other opiates more reinforcing, and that MMT patients are more likely to smoke when taking MMT as a means of either counteracting the sedative effects of

methadone or to produce a more pleasure experience when tobacco and methadone are used concurrently (Do et al., 2017).

Cannabis and Cannabis Use Motives

Cannabis, derived from the *Cannabis sativa* plant, is one of the most widely used drugs in the world, and is currently a legal substance in Canada and a few other jurisdictions. It is used both recreationally and medically and can be consumed in a variety of different ways, although it is most commonly smoked (Kumar et al., 2001). However, the cannabis plant contains over 120 unique cannabinoids, several of which have been shown to have unique pharmacological activity and interactive effects (Morales et al., 2017). The primary ingredient in Cannabis is tetrahydrocannabinol (THC) and is responsible for the drug's psychoactive effects. In contrast, cannabidiol (CBD) is a non-psychoactive cannabinoid, which appears to counteract the anxiogenic effects of THC (Bergamaschi et al., 2011; Blessing et al., 2015), enhance some effects of THC, and has anticonvulsant activity (Morales et al., 2017).

Because different strains of cannabis will have varying concentration in terms of these primary cannabinoids, and pharmacokinetics can vary depending on method of use, cannabis can have a variety of pharmacological effects in humans. When smoked, THC and other cannabinoids are absorbed through the lungs, travel through the bloodstream and reach the brain leading to apparent effects within minutes. The pleiotropic effects of cannabis combine many of the properties of alcohol, tranquillisers, opiates, and hallucinogens. As such, cannabis can have anxiolytic, anxiogenic, sedative, analgesic, and psychedelic properties (Morales et al., 2017).

For example, even relatively low doses of THC can induce a euphoriant effect or “high”, characterized by increased sociability, appetite stimulation, and decreased anxiety, depression, and tension; occurring within minutes and lasting 2 hours depending on dose. In inexperienced users, or those with genetic or pharmacological vulnerabilities, higher doses of cannabis can also be responsible for opposite reactions, characterized by severe anxiety, panic symptoms, paranoia, and in some cases psychosis. Cannabis can produce perceptual changes (e.g., enhance the experience of colors, music, and emotions), distort spatial and time perception, and at high doses induce hallucinations. Similar to alcohol and tranquilisers, cannabis impairs cognitive and psychomotor performance (e.g., negatively affects motor coordination, driving, concentration, and working memory; Morales et al., 2017). The long-term effects of chronic cannabis use appear to negatively affect cognition (i.e., attention, processing speed, memory), although the extent to which these effects are permanent or causal is unclear (Crane et al., 2013; Crean et al., 2011; Fontes et al., 2011; Schweinsburg et al., 2008). Withdrawal symptoms typically occur within the first 2 days of abstinence and include dysphoria, restlessness, decreased appetite, insomnia, nightmares, irritability, anxiety, and somatic symptoms (Bonnet & Preuss, 2017).

The literature on cannabis use motives emerged from the DMQ-R with the publication of the Marijuana Motives Measure (MMM; Simons et al., 1998; Zvolensky et al., 2007). The same four motives present for drinking were replicated for cannabis, with the addition of a fifth “expansion” motive, reflecting the desire to enhance one’s experiential awareness/perception which more acutely maps onto cannabis’ psychedelic properties. Other research with young adults also found the presence of boredom,

experimentation, and sleep motives, highlighting the importance of considering the developmental stage of the population under study when examining motives for use (Lee et al., 2009). A recent meta-analysis of the five main cannabis motives revealed that enhancement, coping, and expansion motives are positively related to greater frequency of cannabis use, while coping and conformity motives are positively related to cannabis use problems (Bresin & Mekawi, 2019).

Stimulant Drugs and Stimulant Use Motives

Stimulants are a class of drugs that comprise both illicit (e.g., speed, crystal meth, powder cocaine, crack cocaine) and medical formulations (e.g., prescription stimulants typically used to treat attention-deficit hyperactivity disorder). This drug class includes cocaine, amphetamines, methamphetamines, and synthetic stimulants (e.g., methylphenidate; Ciccarone, 2011). These drugs act on central and peripheral nervous systems and produce psychostimulant actions (e.g., increased alertness, hyperactivity, decreased appetite, increased self-confidence, and increased euphoria). Further, they can have wide-ranging physical consequences, including affecting the cardiovascular and ocular system. The potential for misuse, abuse, and dependence is high and appears to vary by substance and form of consumption, such that faster pharmacokinetics (e.g., injection or smoking over ingested routes) aid abuse potential (Ciccarone, 2011). In higher doses and with chronic use, stimulants can cause acute psychosis (i.e., confusion, delusions, paranoid thinking, and stereotyped compulsive behaviour; Docherty & Alsufyani, 2021), dysphoric effects (e.g., insomnia, anxiety, irritability, panic attacks; Ciccarone, 2011), and physical dependence.

Withdrawal from stimulants can produce dysphoria, and sleep, appetite, and motor disturbances similar to those seen in depressive disorders. Severe depressive symptoms can last between 8-48 hours, while more mild symptoms can persist for 2 weeks (Kosten & O'Connor, 2003). The dysphoric state induced by stimulant withdrawal contributes to craving and relapse (Ciccarone, 2011).

Motives for stimulant use do appear to vary by population characteristics (e.g., student samples vs. clinical samples; users vs. misusers). Blevins and colleagues (2017) adapted the DMQ-R to measure motives for prescription stimulant misuse among university students, adding items measuring motives relating to improving academic performance and weight loss, respectively. They confirmed all of the existing factors measured by the DMQ-R and MMM and added 2 new factors relating to academic performance and weight loss. Academic performance was the most commonly-endorsed motive, and conformity the least commonly endorsed. This mirrors epidemiological studies citing alertness/concentration, academic improvements, and euphoria as principal motives for prescription stimulant misuse (Compton et al., 2018). Thurn and colleagues (2017) developed the Amphetamine-type stimulants Motive Questionnaire (AMQ) to measure motives for use in a clinical population of individuals presenting for drug addiction treatment. They were able to replicate the original four DMQ-R scales.

Stimulants are frequently used by MMT clients, presumably to increase energy, euphoria, allay methadone side effects, and modify the potency of other drugs (Shariatirad et al., 2013; Singh et al., 2019). Weekly methamphetamine use has been found to be independently associated with methadone discontinuation in a prospective cohort study of a sample of 875 people who use drugs (Mackay et al., 2021).

Understanding stimulant motive endorsement among MMT clients is important given the deleterious effects that stimulant misuse can have on treatment outcomes (Baumeister et al., 2014; DeMaria et al., 2000).

Opioids and Opioid Use Motives

Opioids are a class of analgesics drugs that are used in both medical (e.g., prescription drugs such as oxycontin, codeine, or morphine) and illicit (e.g., heroin) forms, for both medical (e.g., pain management) and recreational (e.g., to get “high”) reasons. Recreational opioid use can take the form of both heroin use or prescription opioid misuse. The primary medical function of opioids are to induce a state of analgesia; as such they are frequently used in the treatment of acute and (with some controversy) chronic pain (Pathan & Williams, 2012). This analgesic effect is also paired with a reduction in consciousness level and euphoria, which greatly heightens the abuse potential of this drug category.

Cicero and Ellis (2017) reviewed the qualitative literature examining the demand for opioid analgesics and the progression from use to abuse. After screening over 2000 articles, they arrived at a final sample of 17 studies. In 11 of these studies that directly examined motivation for continued use, several distinct motives for use emerged. This included self-medication of pain (n=6), use for altering mood/pleasurable feelings (n=5), coping with life stressors (n=8), or self-medication of anxiety, depression, emotional pain, or trauma (n=8). Barth and colleagues (2013) sampled 86 non-treatment seeking individuals with prescription opioid dependence. The most common motives for using prescription opioids were to relieve pain (81%), to get high (73.8%), to increase energy (71%), to decrease anxiety (51.2%), and to improve sleep (35.7%). Although developed

in undergraduates, Jones et al. (2014) adapted the DMQ-R Drinking Motives Questionnaire (Cooper, 1994) to the opioid context by replacing the conformity motive with pain motives, and derived a 4-factor model which included pain, social, enhancement, and coping motives for opioid use.

Although the initial exposure to opioids appears to be largely dominated by enhancement or coping motives (including coping with physical and emotional pain), the development of physical dependence and wanting to avoid the associated withdrawal syndrome is thought to become the leading motivation for continued use. Indeed, withdrawal motives appear to play an important role in the maintenance of opioid use among clinical populations (Blevins, Lash, et al., 2018).

As with other drugs of abuse, repeated use leads to tolerance, which in turn leads to physical dependence/withdrawal. Although pain relief, self-medication of anxiety and depression, or pleasure seeking often contribute to the initial use of opioids, avoidance of opioid withdrawal is thought to be a critical maintaining factors in opioid addiction (Blevins, Lash, et al., 2018; Cicero & Ellis, 2017; Kosten & Baxter, 2019). Indeed, in 8 out of 11 studies surveyed by Cicero and Ellis (2017), participants described the development of physical dependence and associated withdrawal syndrome as becoming the leading motivation for continued use. As prescription opioids became unavailable or too expensive, many people with opioid use disorder transitioned to heroin use or other synthetic opioids (Cicero et al., 2017, 2020; Cicero & Ellis, 2017; Compton et al., 2016).

Opioid withdrawal is characterized by intense and painful flu-like symptoms. These can include aches/pains, muscle spasms, tremors, abdominal cramps, nausea, vomiting, diarrhea, anxiety, irritability, insomnia, hot flashes, heart palpitations,

sweating, and lacrimation (Kosten & Baxter, 2019). The severity and intensity of withdrawal symptoms is dependent on the half-life of the opioid in question, the duration of opioid use, and patient-specific characteristics. For example, abrupt cessation of a short-acting opioid such as heroin or oxycodone is associated with severe withdrawal symptoms that begin within 12 hours after a missed dose. These symptoms peak at 36-72 hours and gradually taper off over the following week. Withdrawal from a longer acting opioid such as methadone will produce milder symptoms, take longer to kick in, but will also typically last longer (Kosten & Baxter, 2019).

Tranquiliser Drugs and Motives for Tranquiliser Use

Tranquilisers are defined here as a drug class that encompasses anxiolytic, hypnotic, and sedative drugs. They are primarily used clinically to treat anxiety and insomnia. This is a wide class of drugs with varying pharmacokinetic effects, although the ones most likely to be misused are anxiolytic drugs. The most common example here would be benzodiazepines, which mediate muscle relaxation, and regulate limbic and cortical areas responsible for emotion (i.e., reduce anxiety) and behaviour (Bond & Lader, 2012). These drugs have high risk of tolerance and dependence, and carry heightened risk of overdose when combined with alcohol or opioids (J. D. Jones et al., 2012). Withdrawal from tranquiliser drugs can resemble alcohol withdrawal syndromes, and symptoms typically develop within 2 to 10 days after cessation (Gupta et al., 2021). However, relative to alcohol withdrawal, withdrawal from tranquilisers/sedatives tends to produce psychomotor and autonomic nervous system signs (Kosten & O'Connor, 2003).

Co-use of tranquilisers is common among 50-70% of individuals seeking detoxification for opioid use disorder (K. W. Chen et al., 2011; J. D. Jones et al., 2012;

Stein et al., 2016; Votaw et al., 2020; Votaw, Geyer, et al., 2019), and is associated with negative treatment outcomes among MMT clients (Brands et al., 2008). The most common motives for tranquiliser misuse appear to relate to self-treatment/coping motives, but other motives such as enhancement have also been reported (Votaw, Geyer, et al., 2019). Indeed, Chen and colleagues (2011) found that 45.5% of MMT clients reported using benzodiazepines for enhancement-related reasons. In a treatment-seeking opioid dependent population, Stein and colleagues (2016) found that the most commonly reported motives for benzodiazepine use are to cope with anxiety (42.6%), enhancement (27.7%), help with sleep (11.4%), and decrease opioid withdrawal (10.2%). It has been suggested that benzodiazepines may alter the pharmacokinetics of opioids and that they have unique pharmacodynamic interactions with each other (i.e., benzodiazepines can increase opioid intoxication or decrease opioid withdrawal symptoms; Votaw, Geyer, et al., 2019; J. D. Jones et al., 2012).

Conclusion

While it has been suggested that motives for use would likely differ across substances given their different pharmacological effects and variations in social context of use (Cooper et al., 2016), in practice this question has seldom been investigated. Methodological limitations including measurement issues and statistical analysis difficulties have prevented researchers from investigating motive endorsement in polysubstance use populations. Indeed, one of the primary analytical challenges of polysubstance use datasets are that they are “unbalanced”, meaning there is a considerable amount of non-random missing data. Bridge Chapter Figure 1 at the end of this chapter highlights this problem relative to this sample by showing the pattern of

polysubstance use observed within our sample. Thus far, most investigations have focused on comparisons between alcohol and cannabis motives (Biolcati & Passini, 2019; Blevins, Lash, et al., 2018; Gavrilova et al., 2020; Simons et al., 2000; Villarosa-Hurlocker et al., 2019). Although several motives scales have been developed for measuring each of the substances described in this chapter, they are typically long and differ in item content making direct comparisons between substances challenging. In contexts where polysubstance use is common, administering multiple long motive measures presents a significant time burden for participants or clients. Study 2 presents a brief novel motives measure, designed to be completed efficiently, which allows for direct comparison of motive endorsement across multiple substances.

Figures

Bridge Chapter Figure 1. Polysubstance Use Pattern in recruited MMT sample (n=138)



Note. Opioids and stimulants are combined drug classes. Participants are ranked from lowest levels of polysubstance use to highest.

**CHAPTER 4. STUDY 2A: DIFFERENT DRUGS COME WITH DIFFERENT
MOTIVES: EXAMINING MOTIVES FOR SUBSTANCE USE AMONG
POLYSUBSTANCE USERS UNDERGOING METHADONE MAINTENANCE
THERAPY (MMT)**

The manuscript prepared below includes this study. Under the supervision of Dr. Sherry Stewart, I developed the research questions and hypotheses, collected some of the data, prepared the dataset for analysis, conducted the analyses, and interpreted the study findings. I wrote the initial draft of the manuscript; then incorporated feedback from co-authors. This manuscript underwent peer-review, and I led the response to the one round of revisions. This manuscript was published in *Drug and Alcohol Dependence* in 2021. See Appendix E for copyright permissions from the publisher. The full reference is as follows:

Mahu, I. T., Barrett, S. P., Conrod, P. J., Bartel, S. J., & Stewart, S. H. (2021). Different drugs come with different motives: Examining motives for substance use among people who engage in polysubstance use undergoing methadone maintenance therapy (MMT). *Drug and Alcohol Dependence*, 229(Pt B).
<https://doi.org/10.1016/J.DRUGALCDEP.2021.109133>

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 (PWEPUs), highlighting the importance of both universal and substance-specific programming.

Keywords: Polysubstance Use, Motives, Opiate Agonist Therapy, Methadone, Opioids

Introduction

According to motivational theory (Cox & 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 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, et al., 2018; Valente et al., 2020). However, the latter are

currently understudied and not included in the latest revision of the DMQ scale (V. V. 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, Lash, et al., 2018; Foster et al., 2016; Gavrilova et al., 2020; Hammarberg et al., 2017; R. E. Jones et al., 2014; Mezquita et al., 2011; Öster et al., 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 (R. E. Jones et al., 2014), stimulants (Thurn et al., 2017, 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 & Passini, 2019; Blevins, Lash, 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 & 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.

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.

Method

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 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).

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.

Materials

Substance Use Interview (Gross et al., 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.

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.

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 $+0.1$ on a standardized parameter) would correspond to a negligible effect size (Kruschke & 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.

Expanded Statistical Details¹

Model Set-Up: Bayesian estimation was chosen as it allowed considerably more flexibility given the limited sample size and large number of parameters, while also providing more intuitive inference and without penalty resulting from multiple comparisons (Rouder, 2014). Non-informative priors were used for all models, such that the posterior distribution was mainly influenced by the data. Four chains were run in parallel with 2000 iterations each (consisting of 1000 warm-up draws), using a maximum tree depth of 20 and an adapt delta of .975. A static seed value (777) was used for reproducibility.

Zero-Inflated Beta-Distribution Models: Visual analogue scale data is a form of proportion data and can be accurately modeled by a zero-inflated beta-distribution. To make full use of all available data, zeroes were entered for outcome data where participants did not use a particular substance in the past 30-days (i.e., equivalent to answering “never” on that motive), allowing for the specification of a mixture model (zero-inflated) that can appropriately analyze unbalanced data. Separate models were estimated for each of the seven motives. Data was modeled as originating from a zero-inflated beta distribution, therefore modeling two separate processes: a dichotomous

¹ **Note:** This section was included in the Online Supplementary section of the final publication. It is included as part of the main text here for convenience.

zero/non-zero process (either endorsing a motive, or not) and a conditional continuous process (how much of that motive is endorsed). Although related to a hurdle model, zero-inflated mixture models can capture the continuous process underlying motive endorsement (the non-zero component), while also accounting for both natural zero values (i.e., used a substance in the past 30-days, but endorsed zero, or “never” on that motive) and zeroes induced via a separate process (i.e., not reporting recent use of a particular substance). Given that the zero-inflated portion of the model results are mostly redundant with the analyses discussed in our previous publication (Mahu, Conrod, Barrett, Sako, et al., 2019) and reflects the prevalence of each type of substance use, we do not discuss those at length here. Model fit was inspected through convergence plots, leave-one-out (loo) cross-validation, and posterior predictive checks, showing overall good fit to the data when modeled as a zero-inflated beta process.

Results

Participant demographics and substance use characteristics in this sample were reported in a previous publication (Mahu, Conrod, Barrett, Sako, 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% to 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% to 21.2% of the total conditional variance in motive endorsement by drug class.

Figure 1 plots the model-predicted motive endorsement within each drug category and within each motive. As results remain very similar after controlling for relevant covariates (see supplemental Figure 1), we will focus our discussion on the original non-adjusted models. Figure 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 Figure 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 (Figure 3). Briefly, these significant differences (i.e., where zero is not included in the 95% credible interval) are as follows:

1. **Enhancement.** Participants endorsed enhancement motives for using cannabis, stimulants, and opioids more so than for tobacco and (consistent with H1) tranquilisers (online supplemental Figure 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 (Figure 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; Figure 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 Figure 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 (Figure 2). Social motives mainly displayed trait like qualities (deviance score = 0.27; Figure 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 Figure 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 (Figure 2). Expansion motives showed both trait and state-like properties (deviance score = 0.55; Figure 4).
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 Figure 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 Figure 2).

Coping with anxiety motives showed both trait and state-like properties

(deviance score = 0.51; Figure 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 (Figure 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 Figure 2, light blue). Coping with depression motives were consistently in the top 3 most endorsed motives across all drug categories (Figure 2). Moreover, this motive dimension showed evidence of both trait and state-like properties (deviance score = 0.43, Figure 3).
6. ***Conformity.*** Consistent with H6, conformity motives were seldom endorsed for all substances and showed no differences between drugs (online supplemental Figure 2, gray). Conformity motives showed the strongest evidence of trait-like properties (deviance score = 0.02, Figure 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 (Figure 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, Figure 3).

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

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.

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 et al., 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, Lash, et al., 2018;

Macmadu et al., 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 et al., 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.

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, Lash, 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. (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.

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.

Tables

Study 2A Table 1. Study Hypotheses by Motive

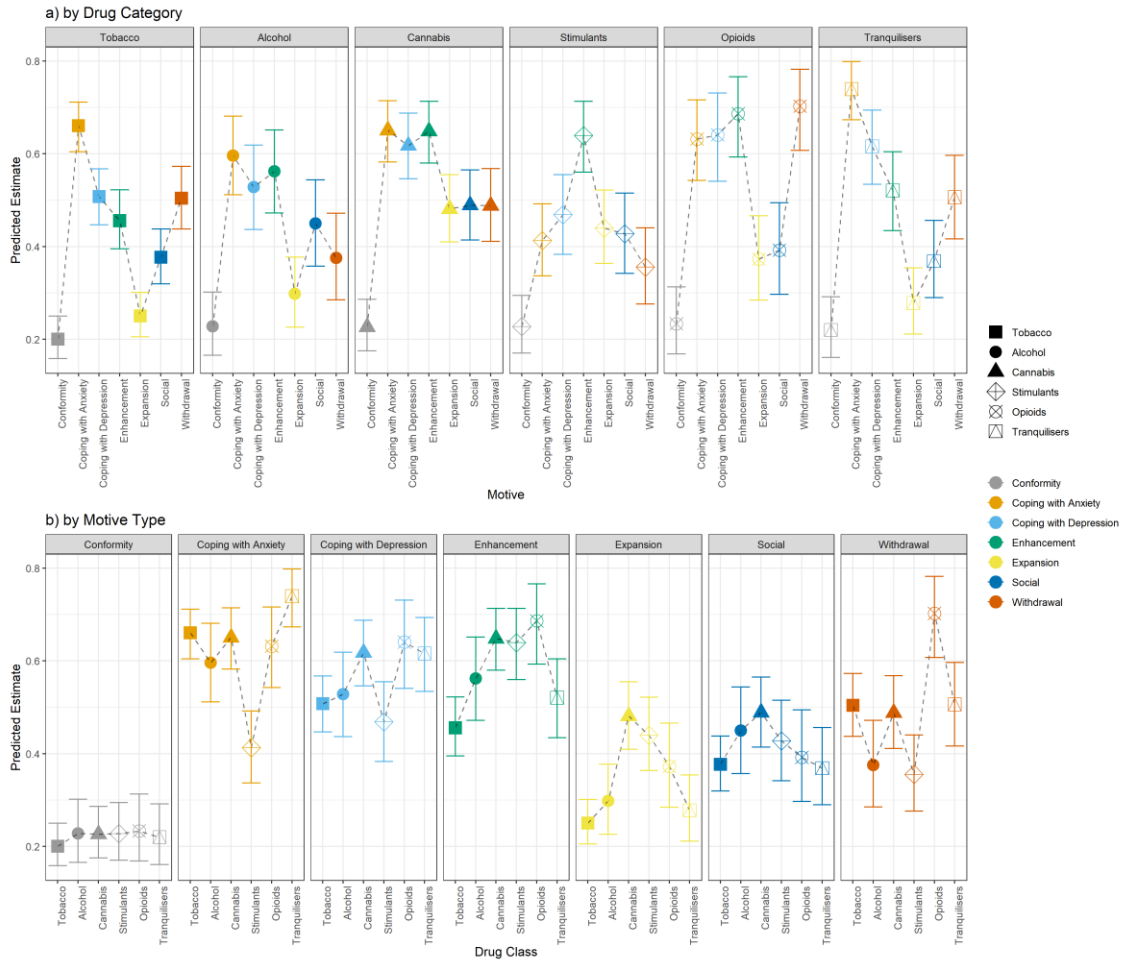
Hypotheses	Rationale
<p>(H1) Enhancement Motives</p>	<p>We expected enhancement motives to be higher for all drug categories relative to tranquilisers. Enhancement motives have been frequently endorsed for alcohol, cannabis, and tobacco in the general population (Cooper et al., 2016), while substances 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; R. E. Jones et al., 2014).</p>
<p>(H2) Social Motives</p>	<p>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).</p>
<p>(H3) Expansion Motives</p>	<p>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).</p>
<p>(H4) Coping with anxiety</p>	<p>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 et al., 2016). Due to their physiological arousal-enhancement effects, we expected stimulants to be least associated with this motive relative to all other drugs (Blevins, Lash, et al., 2018).</p>
<p>(H5) Coping with depression</p>	<p>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.</p>
<p>(H6) Conformity Motives</p>	<p>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).</p>
<p>(H7) Withdrawal</p>	<p>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 & 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.</p>

Study 2A 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%	--	--

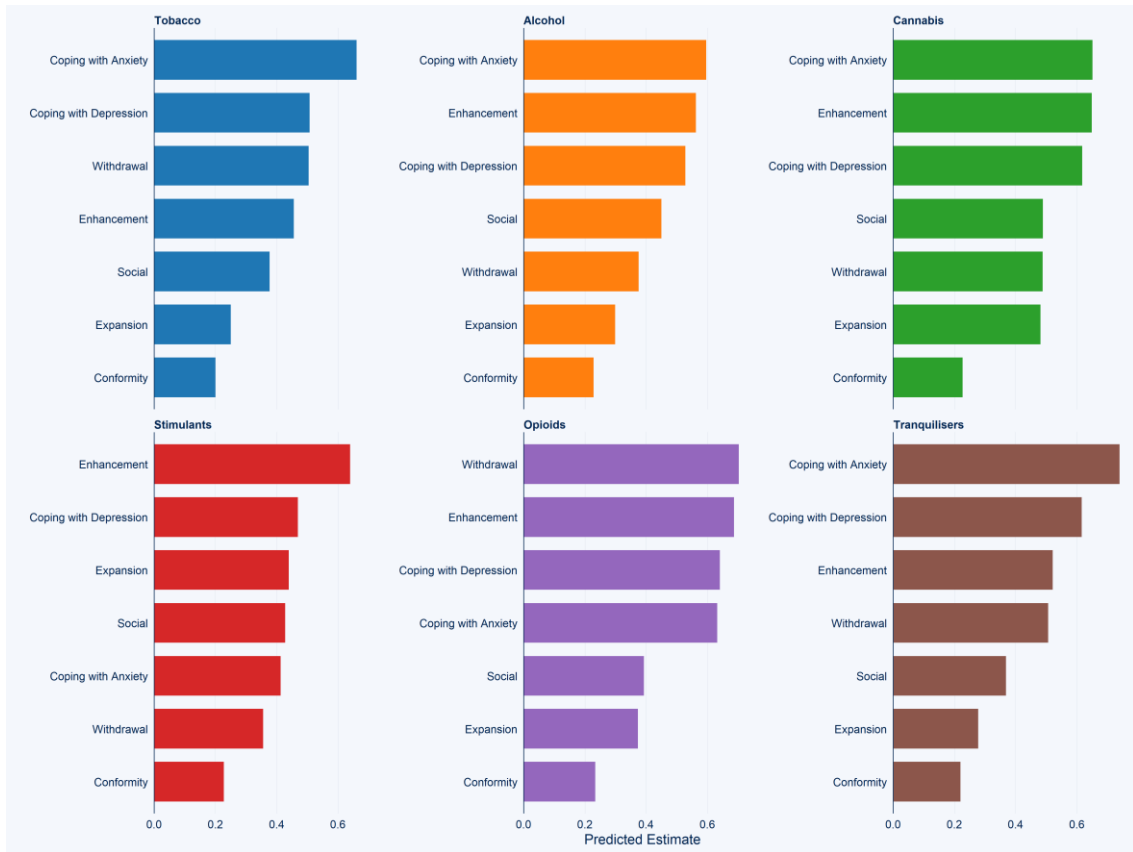
Note. Rx = Prescription. Other Stimulants = Street drugs including Methamphetamine, Speed, Crystal Meth, Ice, etc. Dashed lines (--) = not applicable.

Study 2A Figure 1. Motive endorsement by Drug Class



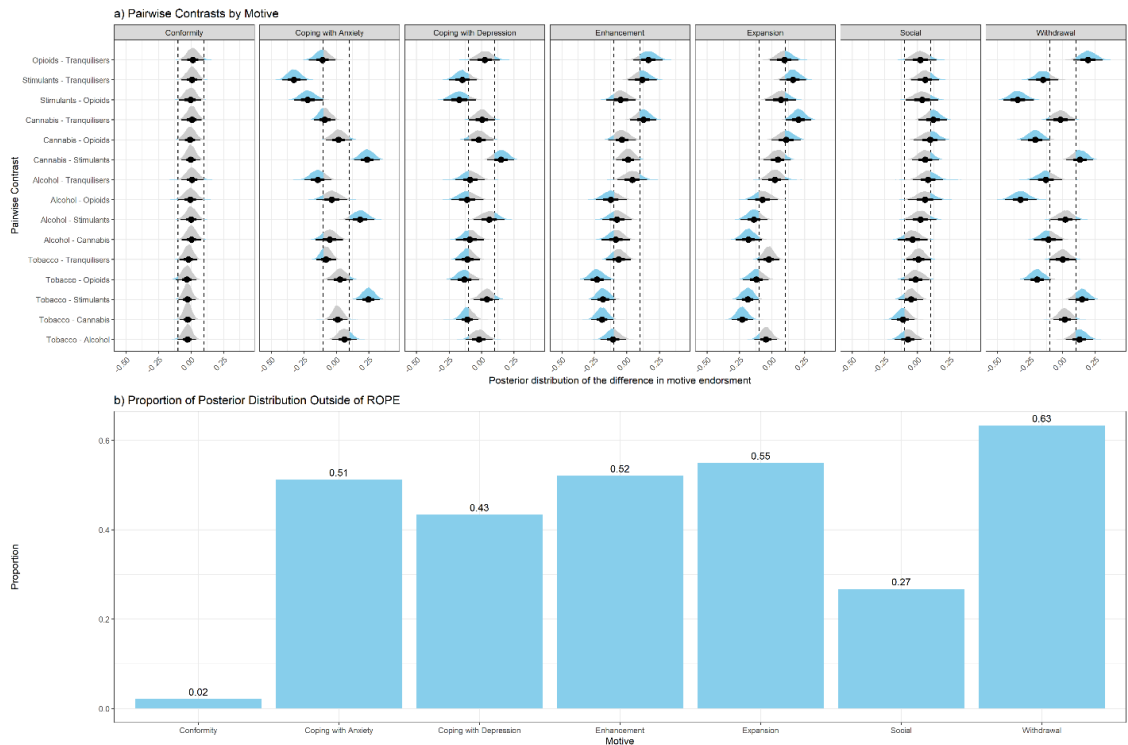
Note. The same data is faceted by drug category (a), to enable comparisons of motives across drug classes, and by motive type (b), to enable comparisons of drug classes across motives. Error bars represent 95% credible intervals for estimates derived from the conditional models.

Study 2A Figure 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.

Study 2A Figure 3. Pairwise Drug Contrasts

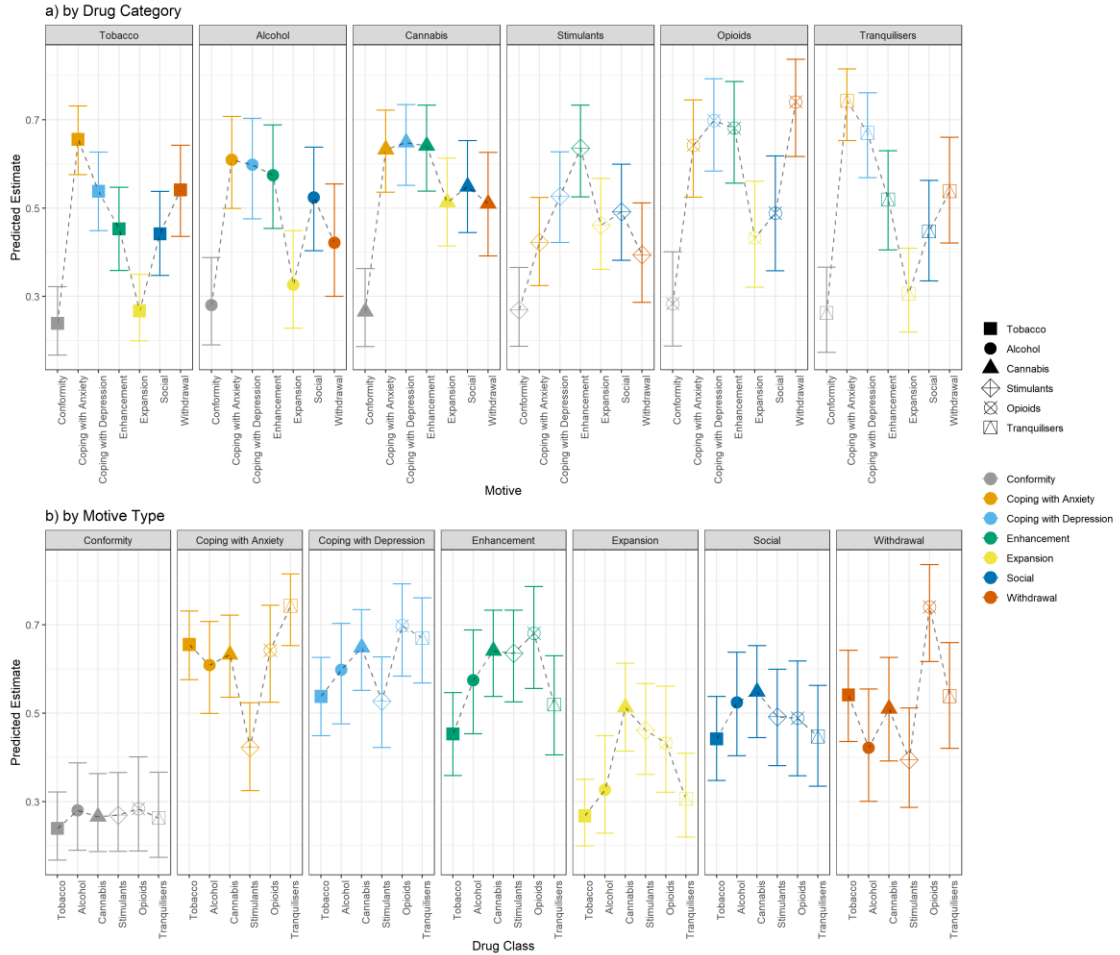


Note. ROPE = Region of Practical Equivalency. All possible pairwise drug contrasts ($n=15$) were calculated by subtracting relevant model parameters and transforming to the original scale (0-1). Density plots display the full posterior distribution (4000 draws) of all possible difference values given 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.

- The ROPE was set at 20%, centered around 0, meaning that a difference of plus or minus .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).
- 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).

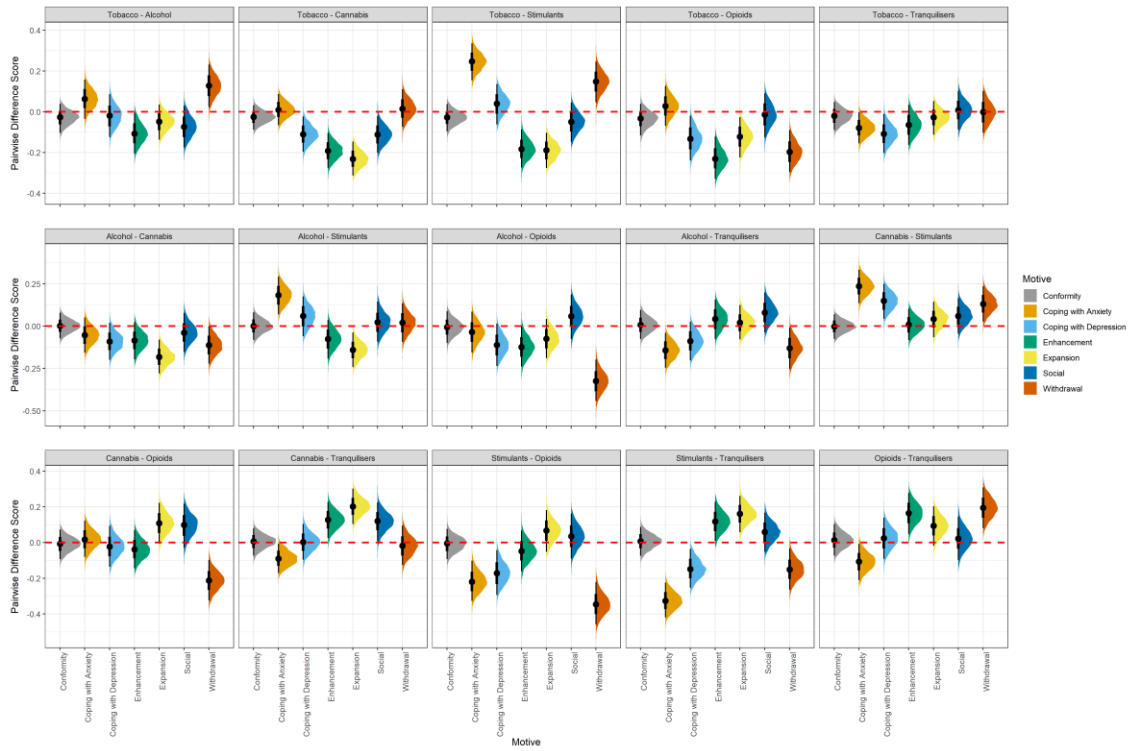
Online Supplementary Figures

Study 2A Online Supplementary Figure 1. Motive endorsement by Drug Class in Co-Variate Adjusted Models (N = 131)



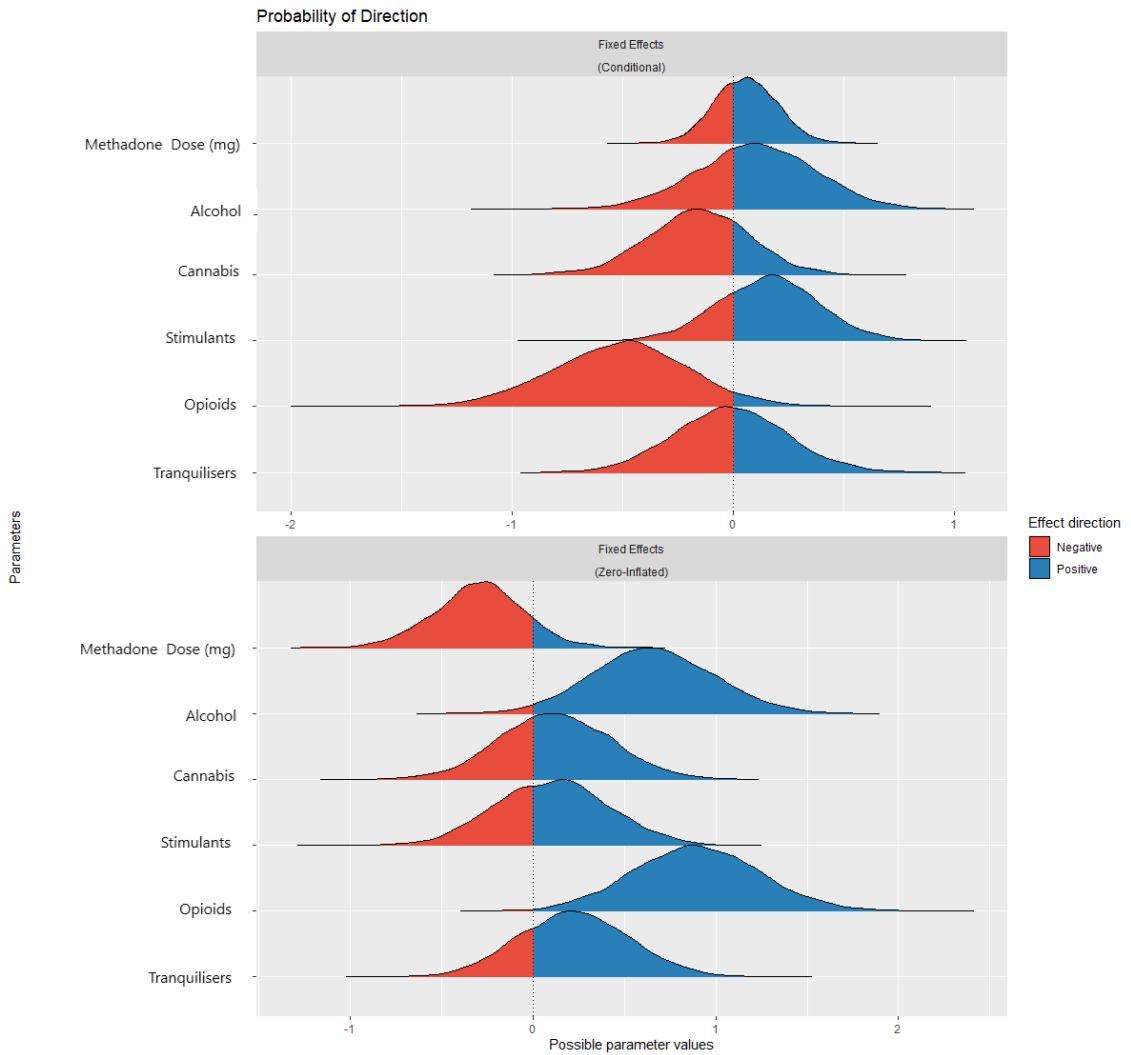
Note. The same data is faceted (a) by drug category, to enable comparisons of motives across drug classes, and (b) by motive type, to enable comparisons of drug classes across motives. Error bars represent 95% credible intervals for estimates derived from the conditional models. Co-variates include age, gender, site, methadone dose (mg), and methadone compliance in the past 30 days (yes = daily compliance, no = missed 1 or more doses in the past 30 days). The same pattern of results is repeated as in Figure 1 in the manuscript (without adjusting for co-variates). Withdrawal motives also included two-way interactions between drug class and methadone dose and compliance.

Study 2A Online Supplementary Figure 2. Pairwise Drug Contrasts Posterior Distributions by Motive



Note. All possible pairwise drug contrasts ($n=15$) were calculated by subtracting relevant model parameters and transforming to the original scale (0-1). The y-axis therefore reflects the difference in motive rating (i.e., the proportion of use occasions this motive was endorsed in the last 30 days) across each possible pairwise comparison. Density plots display the full posterior distribution (4000 draws) of all possible difference values given the data for each motive. 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. The dashed horizontal red line highlights the difference score of zero (no difference). When the 95% credible interval is above the red dashed line, this indicates that the first drug in the contrast pairing is endorsed more frequently. When this interval is found below the red dashed line, this is evidence that the second drug in the contrast pairing being endorsed more frequently. A longer distance from the red dashed line represents a stronger difference in the endorsement of that motive across the two drugs.

Study 2A Online Supplementary Figure 3. Withdrawal Motives and Interactive Effects of Methadone Dosage by Drug Class



Note. Y-Axis lists the main effect of methadone dose and its interactive effects with each drug category. Probability of direction (pd) is an index of effect existence which represents the certainty that an effect is in either a positive or negative direction. It is computed using the proportion of the posterior distribution of possible parameter values that is either positive or negative. Note that a positive effect direction in the Zero-Inflated model reflects increased probability of reporting a motive value of zero (i.e., no motive rating).

CHAPTER 5. TRANSITION FROM STUDY 2A TO 2B

Although a relationship between SURPS personality traits and motives has been established for some substances (see Chapter 1), relatively few studies have examined this relationship in clinical populations (e.g., SUD treatment clients, including MMT clients), in substances beyond alcohol, and no studies have looked at each class of drugs concurrently. Schlauch et al., (2015) is one of the few studies that looked at the relationship between SURPS personality and DMQ-R motives among an inpatient SUD population, where they examined both drinking motives and drug use motives (collapsed across all drug categories). While I review the findings of this study in the next chapter, the short story is that they did not find any theoretically relevant relationship between personality and drug use motives, with the exception of impulsivity being associated with non-specific motive endorsement. Part of the reason might be because they combined all drugs into one category, which fails to consider the variability in motive endorsement between drug classes. Therefore, any specific personality-motive effects would be masked by the noise introduced through combining drugs with very different pharmacological effects. Other researchers that have attempted to look at drug use motives have run into similar problems, explaining why they resort to only examining the most commonly endorsed substances (e.g., alcohol and cannabis; Biolcati & Passini, 2019).

Study 2B is an extension of the analyses in Study 2A to also include personality by drug interactions on motive endorsement. While the data suggests that personality does appear to be associated with theoretically relevant recent substance use patterns (Study 1), and that there are differences in the relative endorsement of each motive across

drug categories (Study 2A), it is unclear to what extent personality interacts with each drug to predict the relative frequency/intensity of these motives (i.e., endorsement of motives continuously, rather than dichotomously). For example, my first study showed that HOP is associated with increased risk of reporting past-30 day opioid use. By virtue of how motives were measured in this study, HOP is associated with endorsing “non-zero motives” for opioids, as participants only filled the motives measure if they endorsed past 30-day opioid use. However, among those who did endorse recent opioid use, it remains unclear whether SURPS personality scores moderate the relative intensity of any of the seven specific motives (e.g., will higher HOP scores be associated with increased endorsement of coping with depression motives). The following study fills this gap by examining personality interactions with each of the six drug classes to determine if specific personality traits are related to particular motives for use.

**CHAPTER 6. STUDY 2B: MOTIVATIONS FOR SUBSTANCE USE AMONG
OPIOID AGONIST THERAPY CLIENTS, INTERACTIONS BETWEEN
PERSONALITY AND SUBSTANCE TYPE**

The manuscript prepared below includes this study. Under the supervision of Dr. Sherry Stewart, I developed the research questions and hypotheses, collected some of the data, prepared the dataset for analysis, conducted the analyses, and interpreted the study findings. I wrote the initial draft of the manuscript; then incorporated one round of feedback from Dr. Stewart. This manuscript is currently being prepared for publication. The full working reference is as follows:

Mahu, I. T., Conrod, P. J., Barrett, S. P., Bartel, S. J., & Stewart, S. H. (unpublished).

Motivations for substance use among opioid agonist therapy clients (OAT):

Interactions between personality and substance type. Manuscript in preparation for submission.

Abstract

Background. Little is known about the relations between personality as measured with the Substance Use Risk Profile Scale (SURPS; Woicik, Stewart, Pihl, & Conrod, 2009) and substance use motives beyond alcohol in clinical samples, such as opiate agonist treatment (OAT) clients. **Method:** Zero-Inflated beta Bayesian linear mixed modeling was used to test whether personality (sensation-seeking, impulsivity, hopelessness, and anxiety-sensitivity) moderates the endorsement of seven distinct substance use motives (enhancement, social, expansion, coping-with-anxiety, coping-with-depression, coping-with-withdrawal, and conformity) across six drug categories (tobacco, alcohol, cannabis, opioids, stimulants, and tranquilisers). OAT clients ($N=138$; 34.1% female, mean age = 40.18) undergoing methadone treatment were recruited across four sites in Canada. **Results:** Sensation seeking was positively related to enhancement and conformity motives for tranquilisers, social motives for tobacco, and coping-with-withdrawal motives for alcohol. Impulsivity was positively related to enhancement motives for stimulants, coping-with-withdrawal motives for opioids, and coping-with-depression motives for alcohol and opioids. Hopelessness was positively related to coping-with-anxiety motives for alcohol, and negatively related to several other motives. Relatively less certain evidence suggested that anxiety sensitivity was positively related to coping-with-anxiety and coping-with-withdrawal motives for tranquilisers and tobacco, among other associations. **Conclusions:** Personality appears to be related to motives for use across a range of drugs in both expected and novel ways, highlighting the need for more research in understanding how motives and personality relate in polysubstance using populations.

Keywords: Personality, Polysubstance Use, Motives, Opiate Agonist Therapy,
Methadone, Opioids

Introduction

Substance use motives are psychologically distinct need states which are thought to drive substance use behaviour as a function of the affective consequences of using a substance (i.e., an increase in positive feelings or decrease in negative ones; Cox & Klinger, 1988). This initial motivational theory led to development of the four factor drinking motives model initially described by Cooper (1994), which differentiates between four distinct motives across two main dimensions for the desired consequences of substance use (approach vs avoidance and self vs other). These substance-use motives include enhancement motives (i.e., seeking pleasure and excitement), social motives (i.e., to make social activity more pleasurable or enticing), coping motives (i.e., to cope with low mood or anxiety), and conformity motives (i.e., to fit in). Other motives have also been proposed (e.g., expansion motives for cannabis; Simons et al., 1998), but these initial four motives have been extensively studied in relation to alcohol specifically, and other drugs occasionally (see reviews by Bresin & Mekawi, 2021; Cooper et al., 2016) (Cooper et al., 2016). Although not included in the modified Drinking Motives Questionnaire – Revised (DMQ-R; Grant et al., 2007), the most widely used measure of substance use motives, research with clinical populations has also identified other motives that should be investigated, such as coping with withdrawal (Blevins, Lash, et al., 2018; Valente et al., 2020). Critically, substance use motives are understood as the final link in the chain leading to substance use and misuse through which other more distal risk factors such as personality exert their influence (Cooper et al., 1994).

Indeed, decades of research has uncovered moderate-sized relationships between various personality traits and specific motives (e.g., neuroticism and coping motives,

extraversion and enhancement motives, anxiety sensitivity and conformity motives; Cooper et al., 2016). According to the personality vulnerability theory of substance misuse (Conrod, Pihl, et al., 2000; Pihl & Peterson, 1995; Woicik et al., 2009), four lower-order personality traits are thought to reflect differences in brain functioning that are related to the motivation to use certain drugs and pharmacological susceptibility to seek out particular drug effects. These traits include anxiety sensitivity (AS; fear of fear), hopelessness (HOP; depression proneness), sensation seeking (SS; preference for novel and exciting stimuli, and low boredom tolerance), and impulsivity (IMP; poor response inhibition) and can be measured with the 23-item Substance Use Risk Profile Scale (SURPS; Woicik et al., 2009). Each trait has been theoretically and empirically linked to specific forms of substance misuse, particular motives for use, and unique co-occurring mental health disorders (Castellanos-Ryan & Conrod, 2012; Conrod, Pihl, et al., 2000). Although the SURPS has mostly been used in youth or young adults (e.g., Comeau et al., 2001), a few recent studies validated the SURPS in clinical populations, such as inpatients (Schlauch et al., 2015), various community samples of substance dependent individuals (Kaminskaite et al., 2020; Long et al., 2018), and opioid agonist therapy clients (OAT; Mahu et al., 2019 - Chapter 2). For example, among OAT clients receiving methadone, AS was shown to be associated with tranquiliser use, HOP with opioid and tranquiliser use, SS with alcohol, cannabis, and stimulant use, and IMP with injection drug use (Mahu et al., 2019 - Chapter 2).

Although SURPS personality-to-motives relations have been extensively studied in non-clinical populations comprised of youth or university students (e.g., Woicik et al., 2009), these relations have largely been understudied in clinical populations, or focused

exclusively on drinking motives. In one of the few studies examining SURPS and motives correlates in clinical samples, Schlauch et al. (2015) investigated the association between SURPS personality traits and both drinking and other drug use motives among substance use treatment inpatients, and largely found that drug motives did not mirror drinking motives. They found that SS was positively associated with enhancement and social motives for alcohol use, while AS and HOP were positively associated with both coping-with-depression and coping-with-anxiety motives for alcohol use. IMP showed non-specific associations with almost every drug use motive, similar to prior findings with drinking motives in non-clinical samples (Woicik et al., 2009). However, beyond separating alcohol from other drugs, these investigators did not separate motives by specific drugs, a methodological limitation shared with others who have attempted to look at substance use motives across many drug categories (e.g., Biolcati & Passini, 2019). Indeed, we have recently shown that a large amount of the within-person variability in the motivational dynamics of drug use is dictated by the type of drug (Mahu et al., 2021 - Chapter 4), suggesting that generalizing motives from one substance to another may not always be appropriate. We extend these previously reported analyses on polysubstance use and drug motives (Mahu et al., 2021 - Chapter 4) to also include SURPS personality traits as an additional set of predictors and investigate whether drug type can moderate the relationship between personality and motive endorsement.

We examined whether personality traits are related to specific motives both generally (main effect of personality) and across specific substance categories (interaction effects). For clarity, hypotheses for main effects will be denoted by M1-4, while those for interaction effects by H1-10. According to the four-factor personality

vulnerability model, individuals high in SS are generally motivated to use substances for positive reinforcement, which includes enhancement, social, and expansion motives (M1; Castellanos-Ryan & Conrod, 2012). Based on previous literature, we expected that this would be particularly true for alcohol (H1; for enhancement and social motives; Schlauch et al., 2015), cannabis (H2; for expansion motives; Hecimovic, Barrett, Darredeau, & Stewart, 2014), and stimulants (H3; for enhancement motives), specifically. The use of these three substances in particular have specifically been linked with SS among OAT clients in this sample (Mahu, Conrod, Barrett, Sako, et al., 2019 - Chapter 2). As in prior research with the SURPS, we expected IMP to show a diffuse and non-specific pattern of use spread across the original motives (M2; Schlauch et al., 2015; Woicik et al., 2009). However, we expected IMP to be positively related to coping-with-withdrawal motives for opioids specifically (H4; Vassileva & Conrod, 2019; Zorrilla & Koob, 2019), given deficits in response inhibition (difficulty resisting urges) and a predisposition towards negative urgency (impulsive action under negative affect) that would likely be activated under conditions of withdrawal. We predicted that those high in HOP would be more likely to use for coping-with-depression motives (M3; Grant et al., 2007), and that this would be true for alcohol (H5; Schlauch et al., 2015), cannabis (H6; Hecimovic et al., 2014) and opioids (H7; Blevins et al., 2018; Mahu et al., 2019), relative to other substances. Additionally, we expected that those high in AS would be more likely to use substances for coping-with-anxiety and coping-with-withdrawal (M4), and that this would more likely be true for tranquilisers (H8) and tobacco (H9), relative to other substances (Guillot et al., 2016; Hearon et al., 2011; Mahu et al., 2019; McHugh et al., 2017; Svicher et al., 2018; Zvolensky et al., 2014). Finally, we hypothesized that those

high in AS would be more likely to use cannabis for conformity motives (H10; Comeau et al., 2001; Hecimovic et al., 2014), relative to other substances. All other relationships were exploratory.

Methods

Participants

We recruited 138 participants from four OAT clinics located in the Halifax Regional Municipality (n = 2) and Montreal (n = 2), as part of a Canadian Research Initiative on Substance Misuse (CRISM)-funded demonstration project. Full participant details have been described in a previous publication (see Mahu et al., 2019 - Chapter 2). Briefly, the sample was mostly composed of men (65.9%) and was largely White (79.7%), with an average age of 40.18 years (SD = 11.56, range 21-71). The inclusion criterion was being a daily witnessed methadone maintenance therapy (MMT) client for at least 30-days, as MMT was the most common form of OAT administered at our collaborating clinics at the time of data collection.

Materials

Substance Use Risk Profile Scale (SURPS; Woicik et al., 2009). The SURPS is a 23-item, 4-point Likert scale (1 *strongly disagree* to 4 *strongly agree*) self-report questionnaire measuring four distinct personality dimensions that are associated with distinct patterns of substance use: Impulsivity (5-items, e.g. “*I often don’t think things through before I speak*”); sensation seeking (6-items, e.g. “*I like doing things that frighten me a little*”); hopelessness (7-items, e.g. “*I feel that I’m a failure*”); and anxiety sensitivity (5-items, e.g. “*It’s frightening to feel dizzy or faint*”). The SURPS is a reliable

and valid measure among youth and adults (Castellanos-Ryan et al., 2013; Krank et al., 2011; Schlauch et al., 2015; Woicik et al., 2009), and is associated with theoretically relevant patterns of substance use among OAT clients (Mahu, Conrod, Barrett, Sako, et al., 2019 - Chapter 2).

Substance Use Questionnaire: Lifetime and recent (past-30 days) use of alcohol, cannabis, amphetamines, hallucinogens, opioids, cocaine/crack cocaine, and various prescription drugs was assessed via a structured interview (S. P. Barrett et al., 2005; Mahu, Conrod, Barrett, Sako, et al., 2019 - Chapter 2). To make full use of the data, pharmacologically similar substances were averaged and combined (i.e., an opioids drug class which included heroin and prescription opioids; a stimulant drug class which included cocaine, crack, prescription stimulants, other stimulants; and a tranquiliser class which included prescription tranquilisers and sedatives) to create six distinct drug classes (tobacco, alcohol, cannabis, opioids, stimulants, and tranquilisers). Hallucinogens were dropped as they were infrequently endorsed in the past 30-days (Mahu, Conrod, Barrett, Sako, et al., 2019 - Chapter 2).

Polysubstance motives Measure (PMM; Mahu et al., 2021 - Chapter 4). Leveraging Smith et al.'s (2011) approach to short-form test development and using items derived from the extant motives literature (Cooper, 1994; V. V. Grant et al., 2007; Simons et al., 1998), we developed a brief, short form, 7-item visual analog scale (VAS) motives measure assessing the endorsement of seven theoretically relevant motives: enhancement, social, conformity, expansion, coping-with-anxiety, coping-with-depression, and coping-with-withdrawal. For example, the item for enhancement motives was worded as follows: “In the past 30 days, I’ve used this drug because it enhances my pleasure (because it’s

exciting, or to get a high/buzz)". Motive endorsement was measured as a proportion of past 30-day use occasions, ranging from "never" to "always", displayed on a 10-cm visual analogue scale. If participants reported past 30-day use of any substance on the Substance Use Questionnaire, they completed the PMM for each substance endorsed. We averaged motives for use across multi-drug classes (i.e., opioids and stimulants) if participants reported more than one drug per class.

Statistical Analysis

Zero-Inflated Beta Linear Mixed Modeling (LMM), using the Bayesian brms package (Bürkner, 2017) in R version 4.0.3 (R Core Team, 2013), was employed to estimate the effects of personality on motives while taking into account variability due to drug categories. These multi-level models involved multiple measurements (level 1) nested within individuals (level 2). Bayesian estimation allows greater flexibility in model specification, particularly with smaller sample sizes, while also providing intuitive inferences not biased by multiple comparisons (Rouder, 2014). Our outcome is a form of proportion data, which can be adequately modeled using a zero-inflated beta distribution, modeling both a dichotomous zero/non-zero process (endorsing any motive) and a conditional continuous process (when endorsed, how frequently). To make use of all available data, zeros were entered for outcome data where participants did not use a substance in the past 30-days, which was captured by the dichotomous portion of each model. Seven separate models were estimated for each motive outcome. As in our previous work (Mahu et al., 2021), non-informative priors were used for all models and four chains were run in parallel with 2000 iterations each (consisting of 1000 warm-up draws) with a maximum tree depth of 20 and an adapt delta of .975. Model fit was

evaluated using convergence plots, leave-one-out (loo) validation, and posterior predictive checks. Models were built in a hierarchical fashion, such that a main effect and an interaction model were tested for each motive sequentially. Fixed effects were estimated for drug class and each of the four personality traits, and their respective interactions terms (within the interaction models only).

Results

Detailed descriptive statistics on this sample are reported elsewhere (Mahu et al., 2019 – Chapter 2). Model parameters for the main effect and interaction models are reported in online supplementary Table 1S and 2S, respectively. The entire posterior distribution for each personality interaction effect is plotted in Figure 1. In the interest of brevity, Table 1 summarizes only the positive directional probabilities of each slope parameter for all outcomes, drug categories, and personality traits, calculated as the proportion of the posterior distribution of relevant parameters showing a positive non-zero estimate (detailed interaction parameter estimates for each outcome can be found in online supplementary Tables 3S-9S). As such, an effect in Table 1 described by a probability of 7% would mean that only 7% of the values contained in the entire posterior distribution of a given effect were positive, and 93% of the possible values for the slope are negative, therefore giving us reasonable evidence that the slope for this hypothetical effect is negative. We highlight any results that have 95% or higher probability of being in either a positive (i.e., >95% probability) or negative (i.e., <5% probability) direction, which corresponds to a parameter value where zero is not included in the 95% credible interval.

Personality Main Effects

After controlling for the effects of drug category (reported in Mahu et al., 2021 – Chapter 4), personality appeared to predict motive endorsement generally (Table 1). Contrary to our expectations, SS was not reliably associated with enhancement (39% probability) or expansion motives (31% probability) for substance use overall (M1). The other hypothesized positive association with social motives was largely in the expected direction but remained somewhat uncertain (M1; 88% probability). IMP did not appear to show a diffuse relationship to drug motives (M2). Rather, IMP was positively associated with coping-with-depression motives (95% probability), and coping-with-withdrawal motives (96% probability). Contrary to our hypothesis, HOP was not associated with coping-with-depression motives overall (M3; 50% probability). Unexpectedly, HOP showed a generalized pattern of negative motive endorsement for almost all motives (i.e., being unlikely to endorse many motives). Specifically, individuals who were high in HOP were unlikely to endorse social motives (0% probability), expansion motives (1% probability), or conformity motives (3% probability). Finally, while individuals high in AS endorsed coping-with-anxiety (M4; 98% probability) and coping-with-withdrawal (M4; 98% probability) motives, unexpectedly, they were also significantly more likely to endorse almost every motive, showing a generalized non-specific pattern of motive endorsement.

Personality Interactions

Sensation Seeking (Figure 2)

Contrary to hypothesis, we did not detect a reliable positive association between SS with enhancement and social motives for alcohol (H1; 24% and 47% probability, respectively), nor did we detect a positive association between SS and expansion for cannabis (H2; 65% probability) or stimulants (H3; 31% probability). However, SS was positively associated with reporting enhancement motives for tranquilisers (96% probability); social motives for tobacco (95% probability); conformity motives for tranquilisers (97% probability); and coping-with-withdrawal motives for alcohol (99% probability).

Impulsivity (Figure 3)

As hypothesized, IMP was positively associated with coping-with-withdrawal motives for opioids (H4; 98% probability). IMP was also positively associated with enhancement motives for stimulants (95% probability); and with coping-with-depression motives for alcohol (99% probability) and opioids (96% probability), but not cannabis (4% probability).

Hopelessness (Figure 4)

Contrary to our hypotheses, although there was a signal (albeit relatively uncertain) pointing towards increased probability of reporting coping-with-depression motives for alcohol (H5; 84% probability), this did not seem to extend to cannabis (H6; 30% probability) or opioids (H7; 22% probability). Instead, HOP was positively associated with coping-with-anxiety motives for alcohol (98% probability). Similarly to the main effect results, HOP was negatively associated with endorsing a variety of motives, including: social motives for cannabis (0% probability) and opioids (3%

probability); expansion motives for cannabis (0% probability); coping-with-anxiety motives for tobacco (3% probability), cannabis (4% probability), and opioids (2% probability); conformity motives for opioids (3% probability); and finally, coping-with-withdrawal motives for cannabis (3% probability).

Anxiety Sensitivity (Figure 5)

The hypothesized relationships between AS and coping-with-anxiety motives for tranquilisers (H8; 91% probability) and tobacco (H9; 92% probability) were largely in the expected direction but remained relatively uncertain. The same can be said of coping-with-withdrawal motives for tranquilisers (H8; 93% probability) and tobacco (H9; 92% probability). As hypothesized, AS was positively associated with conformity motives for cannabis (H10; 96% probability), but also for tranquilisers (99% probability).

Unexpectedly, AS was also positively associated with a variety of motives across several drug classes, including: enhancement motives for tobacco (98% probability); social motives for opioids (99% probability); expansion motives for tobacco (97% probability), cannabis (98% probability), and opioids (99% probability); and finally, coping-with-depression motives for tobacco (96% probability), cannabis (100% probability), and tranquilisers (98% probability).

Discussion

In this study, we extend our previous modeling looking at the stability of motives across drug categories (Mahu et al., 2021 – Chapter 4) to also examine whether personality has a generalized impact on motive endorsement across drug categories, or if drug category moderates this relationship between personality and motive endorsement.

Our findings contribute to extending the literature on the motivational model of substance use (Cooper et al., 2016) and the four-factor model of personality vulnerability (Castellanos-Ryan & Conrod, 2012; Conrod, Pihl, et al., 2000) as it applies to a clinical population of OAT clients with varying levels of polysubstance use.

Sensation Seeking

Individuals high in SS are thought to be pharmacologically more sensitive to the rewarding properties of substances, and to use substances primarily for enhancement reasons (Woicik et al., 2009). Although SS is associated with increased likelihood of reporting past 30-day alcohol, cannabis, and stimulants use in this sample (Mahu, Conrod, Barrett, Sako, et al., 2019 - Chapter 2), SS was not reliably associated with enhancement motives generally nor specifically for any of these three substances, as had been initially hypothesized.

Instead, SS was positively associated with enhancement and conformity motives for tranquilisers specifically. Several studies with OAT populations report that patients commonly take sedatives and tranquilisers for pleasure or to get high as one of the primary motives (K. W. Chen et al., 2011; Fatséas et al., 2009; Iguchi et al., 1993; Mateu-Gelabert et al., 2017; Stein et al., 2016), including enhancing the effects of methadone or other opioids (J. D. Jones et al., 2012; Mateu-Gelabert et al., 2017). It is possible therefore that SS is a unique risk factor leading to tranquiliser misuse through enhancement motives among OAT clients. Additionally, although conformity motives were rarely endorsed in this sample (Mahu et al., 2021 – Chapter 4), they could be activated in social situations (Comeau et al., 2001). Individuals high in SS may be particularly vulnerable to also use tranquilisers (or any drug more generally) if others are

also using (Liebrenz et al., 2015). This could potentially be mediated through fear of missing out on the experience, particularly if opportunities to use or use in social settings are rare. Fear of missing out was found to mediate the relationship between SS and smartphone addiction among adolescents (Wang et al., 2019), and may potentially also play a role in explaining the association between SS and conformity motives for tranquilizer use among OAT clients.

Second, alcohol use was heavily motivated by coping-with-withdrawal motives in SS individuals. This might be secondary to alcohol withdrawal given SS's well-documented association with alcohol misuse vulnerability (Brunelle & Pihl, 2007; Mahu, Conrod, Barrett, Sako, et al., 2019 - Chapter 2; Woicik et al., 2009). OAT clients high in SS may need additional help with managing withdrawal from alcohol. Finally, social motives appeared to motivate tobacco use for individuals high in SS, consistent with prior research linking SS and social smoking behaviour (Zuckerman et al., 1990).

Impulsivity

In a sample of inpatient substance dependent individuals, Schlauch et al. (2015) found that IMP was associated with a diffuse pattern of drug use motives. This is consistent with the drinking motives profile associated with IMP reported by Woicik et al. (2009) in young adults. In contrast, when examining personality interactions with specific substances in OAT clients, our results suggest that IMP is positively associated with coping-with-depression and coping-with-withdrawal motives across all substances, with some more limited support for links of IMP to enhancement motivated use.

First, IMP was positively associated with enhancement motives for recent stimulant use specifically. While higher IMP has long been identified as both a vulnerability to, and a consequence of, substance misuse (e.g., see reviews by Trull et al., 2016; Vassileva & Conrod, 2019; Winstanley et al., 2010), SURPS-IMP has been associated with stimulant/cocaine use among substance dependent populations (Conrod, Pihl, et al., 2000; Schlauch et al., 2015), adolescents (Stewart, Chinneck, et al., 2021; Woicik et al., 2009), and emerging adult samples alike (Chinneck et al., 2018). In the present MMT sample, IMP was associated with increased likelihood of injection drug use, around half of which was comprised of stimulant injection (Mahu, Conrod, Barrett, Sako, et al., 2019 - Chapter 2). This specific association between enhancement motives and stimulants is consistent with Schlauch et al.'s (2015) finding that IMP is uniquely associated with enhanced susceptibility to the reinforcing effects of stimulants through enhanced cue-reactivity to cocaine cues. Taken together, this provides additional support that targeted interventions aimed at reducing substance use need to consider enhancement-specific motives for stimulants among high IMP clients.

Second, IMP was also positively associated with coping-with-depression motives for alcohol and opioids. It is possible that through impaired decision making abilities and propensity towards negative urgency common among highly disinhibited people, IMP leads to additional difficulties in various areas of living and compounding life stressors, through which depression symptoms are eventually expressed (Granö et al., 2007). Indeed, trait impulsivity has been associated with affective disorders generally and depression specifically (Corruble et al., 2003; Peluso et al., 2007; Swann et al., 2008). Interestingly, even when controlling for other personality traits (e.g., HOP, which is

thought to measure trait-like depression proneness), higher IMP OAT clients reported higher coping-with-depression motives for alcohol and opioids specifically, which is consistent with the short-term antidepressant-like pharmacological properties of these two drug classes (Ciccocioppo et al., 1999; Rouine et al., 2018; Saxena & Bodkin, 2019; Wolfe et al., 2016). Interestingly, IMP was negatively associated with coping-with-depression motives for cannabis specifically. When examining the other cannabis related motives, IMP was more closely linked to enhancement motives; however, this effect was relatively less certain (at 88% probability) and needs further replication. Nevertheless, it is possible that among high-IMP MMT clients who also use other substances, cannabis may potentially be used for positive mood induction, rather than to cope with negative affect as seen with alcohol and opioids, perhaps because these latter drug choices are more readily available or more strongly preferred for self-medication purposes.

Finally, IMP was also uniquely related to coping-with-withdrawal motives for opioids specifically, highlighting the importance of effective medication management for IMP opioid dependent individuals. Given that impulsivity is thought to be related to increases in withdrawal-moderated drug craving among OAT clients (Li et al., 2021), individuals high in IMP may be particularly vulnerable to opioid relapse when experiencing withdrawal (Adinoff et al., 2007). This might occur because IMP clients are more likely to take impulsive actions when experiencing the negative affect (i.e., negative urgency) caused by intolerable withdrawal states (Vassileva & Conrod, 2019; Zorrilla & Koob, 2019). High levels of negative urgency in IMP clients may also potentially explain the previously discussed association of IMP with coping-with-depression motives, where these aversive affective states (e.g., withdrawal, sadness) are managed by substance use.

Overall, these results suggest that deficits in response inhibition among IMP may be contributing to self-medication motives for substance use (e.g., to cope with withdrawal or depressive states) and to chasing immediate reward and pleasure (e.g., through stimulant use).

Hopelessness

HOP is thought to represent a construct of trait-like depression proneness, characterized by a sensitivity to punishment and a negative attribution style (Conrod, Pihl, et al., 2000). When examining main effects, it seems that HOP is generally associated with lesser likelihood of endorsing almost all substance use motives, with the strongest evidence for negative associations with social, expansion, and conformity motives. This is not entirely surprising given the link between HOP and depression (Conrod, Pihl, et al., 2000). Because active depressive symptoms are related to anhedonia and to reductions in activity, motivation, and social behaviour, this likely results in decreased likelihood of reporting expansion, social, or conformity motives for substance use.

In this sample, we have previously shown that HOP is associated with past-30 day opioid use (Mahu, Conrod, Barrett, Sako, et al., 2019 - Chapter 2), which we hypothesized occurred through self-medication of their negative affect symptoms. However, contrary to our expectations, HOP was not reliably associated with coping-with-depression motives overall, nor for opioids specifically. Further, there was little evidence of specificity between coping-with-anxiety and coping-with-depression motives, similar to other studies investigating SURPS correlates in clinical populations (Schlauch et al., 2015). This suggests that high-HOP OAT clients may be using opioids

for another motive that has not yet been explored, for example habit, boredom, or pain relief (Blevins, Lash, et al., 2018; R. E. Jones et al., 2014; Rigg & Ibañez, 2010; Schepis et al., 2020; Votaw, McHugh, et al., 2019). The construct of HOP has been bi-directionally associated with chronic pain and other chronic health problems (Gustin et al., 2013; Sheng et al., 2017), and future research should examine whether pain relief motives are particularly relevant for high HOP individuals.

More specifically, the overall pattern of HOP being associated with lesser endorsement of substance use motives was also maintained in interactions with specific substances, with one notable exception. Our modeling suggested strong evidence of substance-specific coping motives for alcohol (primarily coping-with-anxiety, but also some weaker evidence for coping-with-depression), suggesting that high-HOP individuals in OAT regulate their negative affect through drinking. This finding was also observed among high-HOP substance abuse treatment inpatients (Schlauch et al., 2015). Given the increased risks associated with co-use of alcohol and methadone (e.g., overdose, Compton et al., 2021), targeting negative affect and decreasing the use of alcohol to cope with anxiety and depression through personality-targeted psychosocial interventions (Conrod, 2016) could potentially be helpful in managing risk for high-HOP OAT clients.

Anxiety Sensitivity

Contrary to our expectations, AS showed a largely non-specific pattern of motives for use, showing positive associations with almost every motive. This pattern appeared to carry over when examining interactions with specific drug classes. Similarly to Schlauch et al. (2015), we did not find specificity in either coping motive as they relate to AS,

suggesting that OAT clients high in AS are likely to use substances to cope with negative affect more broadly. As AS is associated with a range of comorbid conditions (e.g., anxiety disorders, depression; see Olthuis et al., 2014), this finding is perhaps unsurprising in a clinical population that is likely experiencing higher rates of psychiatric comorbidities (Connor et al., 2014; Thornton et al., 2012). However, a positive association between AS and coping motives was most reliably detected for tobacco, cannabis, and tranquilisers, with tranquilisers showing more specificity towards all negative reinforcement motives (e.g., coping-with-anxiety and -depression, conformity, and coping-with-withdrawal) relative to positive reinforcement motives (e.g., enhancement, social, expansion). We replicated prior results showing an association between AS and conformity motives for cannabis use (Comeau et al., 2001; Hecimovic et al., 2014), and extended this result to tranquilisers among OAT clients. Interestingly, given that AS was associated with past 30-day tranquiliser use in this sample (Mahu, Conrod, Barrett, Sako, et al., 2019 - Chapter 2), these results suggest that both coping and conformity motives (all part of a negative reinforcement pathway) are possible mechanisms underlying this association.

Surprisingly, expansion motives were positively associated with AS across several drugs, particularly for tobacco, cannabis, and opioids. Given that AS is associated with a fear of one's own bodily sensations, a possible explanation for this finding might be that OAT individuals high in AS may be attracted to substances that can enhance experiential awareness of one's surroundings and therefore possibly distract from one's own feared internal physical sensations. Corresponding high probabilities in positively endorsing coping motives for the above-mentioned substances also provide some support

for this hypothesis; however, given the novelty of this finding, it needs to be replicated in other samples.

Finally, AS was associated with enhancement motives for tobacco specifically. Although inconsistent with initial theory (Stewart et al., 1999), this result is consistent with prior research demonstrating that positive reinforcement mechanisms maintain smoking in high-AS individuals, and that AS is associated with increased subjective effects of smoking (M. Wong et al., 2013).

Strengths and Limitations

Because of considerable variability in the prevalence of past 30-day use across different substances, certain interaction effects presented with wider credibility intervals and more uncertainty. Although our Bayesian approach allowed us to fully quantify this uncertainty, future studies will benefit from more precise estimates afforded by larger and more diverse samples. Second, while the brevity of our single-item motives measure allowed us to quickly evaluate various motives across multiple drug categories, this came at the cost of not being able to test this measure's reliability and making direct comparisons with extant multi-item measures more complicated. Nonetheless, future studies may benefit from the use of this short motives measure in settings involving high rates of polysubstance use where use of long form substance use motives measures with multiple substances is infeasible.

Conclusion

In summary, we showed that motives for use across different drug categories within the same individuals are related to specific personality traits, building on a large

literature connecting personality and substance use motives (Castellanos-Ryan & Conrod, 2012). Some of these relations were theory consistent (e.g., IMP and withdrawal motives, AS and coping-with-anxiety) and others were relatively unexpected, providing opportunities for new research to replicate and further understand these novel findings. Clinicians working with clients engaging in polysubstance use may benefit from considering the unique role of personality in their case conceptualization, assessment, and treatment.

Tables

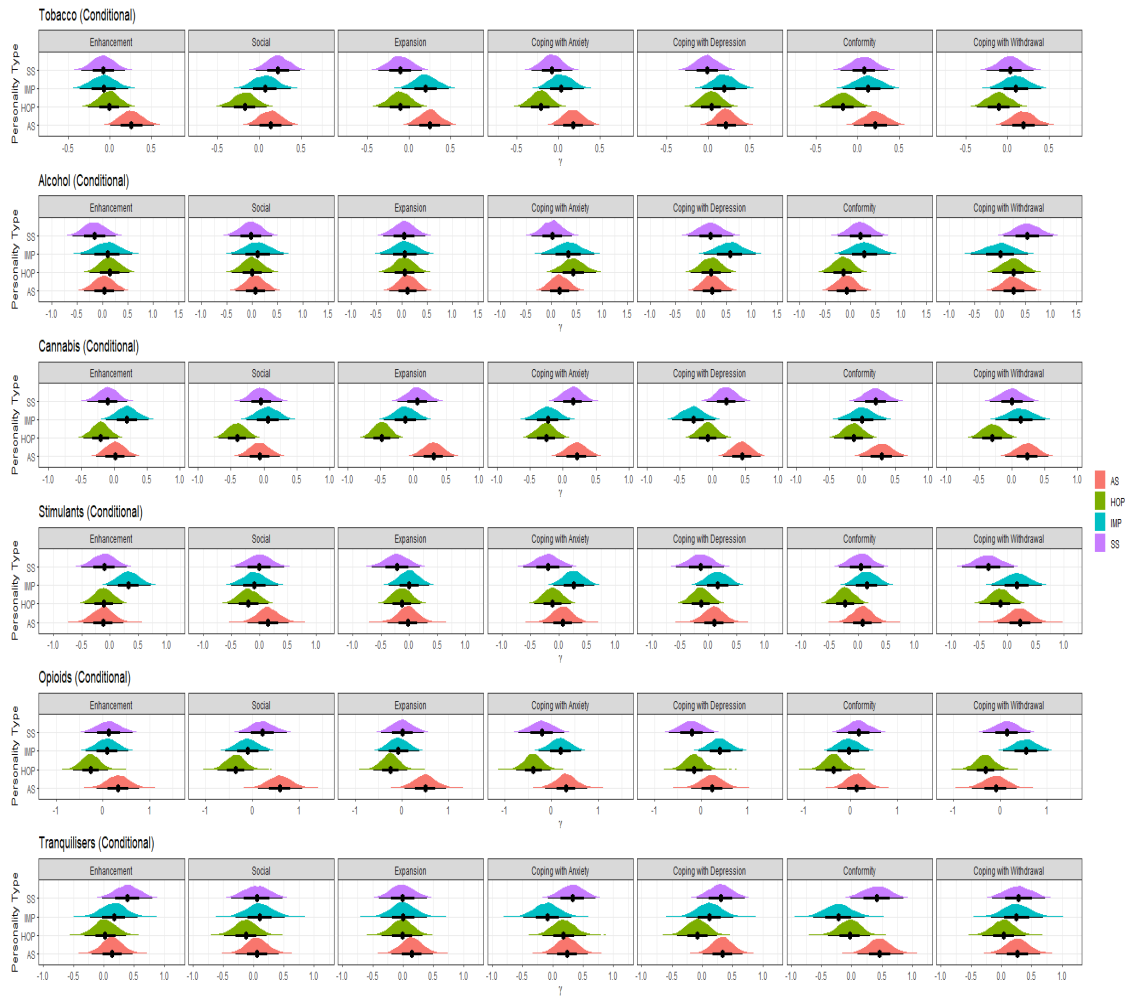
Study 2B Table 1. Percentage of Posterior Distribution with Positive Slope Values for Main Effects and Personality by Drug Class Interactions

Effect	Personality	% of Posterior Distribution with positive slope values for substance use motives						
		Enh	Soc	Exp	CwA	CwD	Conf	CwW
Main Effect	SS	0.39	0.88	0.31	0.54	0.76	0.93	0.77
Tobacco	SS	0.28	0.95*	0.23	0.26	0.46	0.69	0.60
Alcohol	SS	0.24	0.47	0.60	0.55	0.79	0.82	0.99*
Cannabis	SS	0.27	0.40	0.65	0.84	0.92	0.90	0.51
Stimulants	SS	0.31	0.50	0.16	0.18	0.26	0.60	0.07
Opioids	SS	0.69	0.80	0.52	0.21	0.21	0.77	0.71
Tranquilisers	SS	0.96*	0.60	0.48	0.94	0.94	0.97*	0.89
Main Effect	IMP	0.93	0.67	0.66	0.80	0.95*	0.70	0.96*
Tobacco	IMP	0.31	0.67	0.92	0.59	0.92	0.79	0.74
Alcohol	IMP	0.64	0.66	0.61	0.90	0.99*	0.86	0.51
Cannabis	IMP	0.88	0.64	0.23	0.09	0.04*	0.50	0.75
Stimulants	IMP	0.95*	0.33	0.50	0.92	0.80	0.79	0.76
Opioids	IMP	0.66	0.34	0.36	0.80	0.96*	0.42	0.98*
Tranquilisers	IMP	0.79	0.69	0.50	0.32	0.72	0.15	0.88
Main Effect	HOP	0.17	0.00*	0.01*	0.12	0.50	0.03*	0.12
Tobacco	HOP	0.48	0.10	0.20	0.03*	0.62	0.10	0.22
Alcohol	HOP	0.76	0.50	0.60	0.98*	0.84	0.22	0.88
Cannabis	HOP	0.07	0.00*	0.00*	0.04*	0.30	0.19	0.03*
Stimulants	HOP	0.26	0.14	0.23	0.26	0.22	0.09	0.24
Opioids	HOP	0.09	0.03*	0.08	0.02*	0.22	0.03*	0.06
Tranquilisers	HOP	0.55	0.25	0.47	0.84	0.33	0.44	0.59
Main Effect	AS	0.90	0.91	0.99*	0.98*	1.00*	0.97*	0.98*
Tobacco	AS	0.98*	0.84	0.97*	0.92	0.96*	0.94	0.92
Alcohol	AS	0.56	0.62	0.74	0.81	0.88	0.35	0.89
Cannabis	AS	0.55	0.34	0.98*	0.91	1.00*	0.96*	0.92
Stimulants	AS	0.24	0.80	0.45	0.65	0.72	0.69	0.87
Opioids	AS	0.93	0.99*	0.99*	0.92	0.85	0.72	0.34
Tranquilisers	AS	0.80	0.62	0.80	0.91	0.98*	0.99*	0.93

Note. SS = Sensation-Seeking. IMP = Impulsivity. HOP = Hopelessness. AS = Anxiety-Sensitivity. Enh = Enhancement motives. Soc = Social motives. Exp = Expansion motives. CwA = Coping with anxiety motives. CwD = Coping with depression motives. Conf = Conformity motives. CwW = Coping with withdrawal motives. * = values of .95

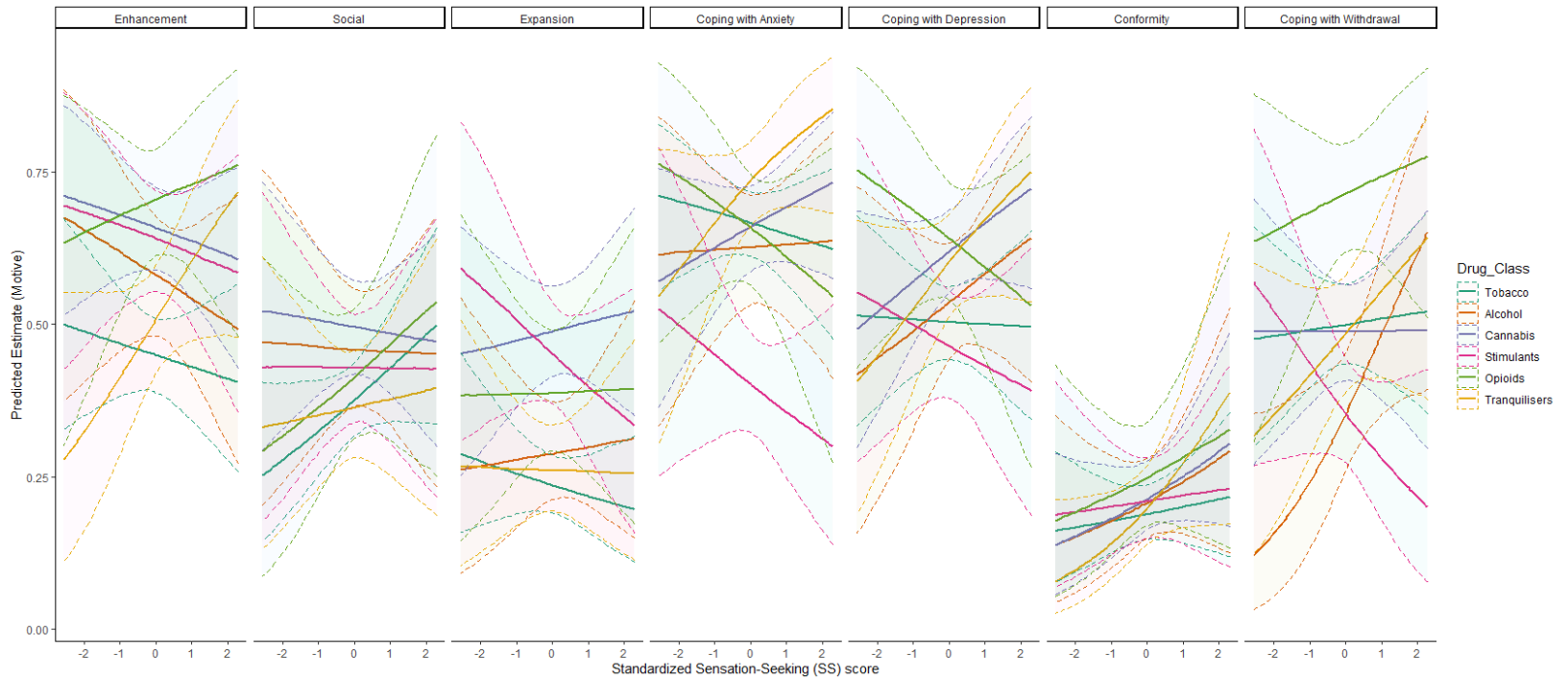
and over indicate that there is a 95% probability or higher that the slope is *positive*. Values of .05 or lower indicate that there is a 95% probability or higher that the slope is *negative*. Zero is not included in the 95% credible interval.

Study 2B Figure 1. Posterior distribution of slope estimates for interaction effects



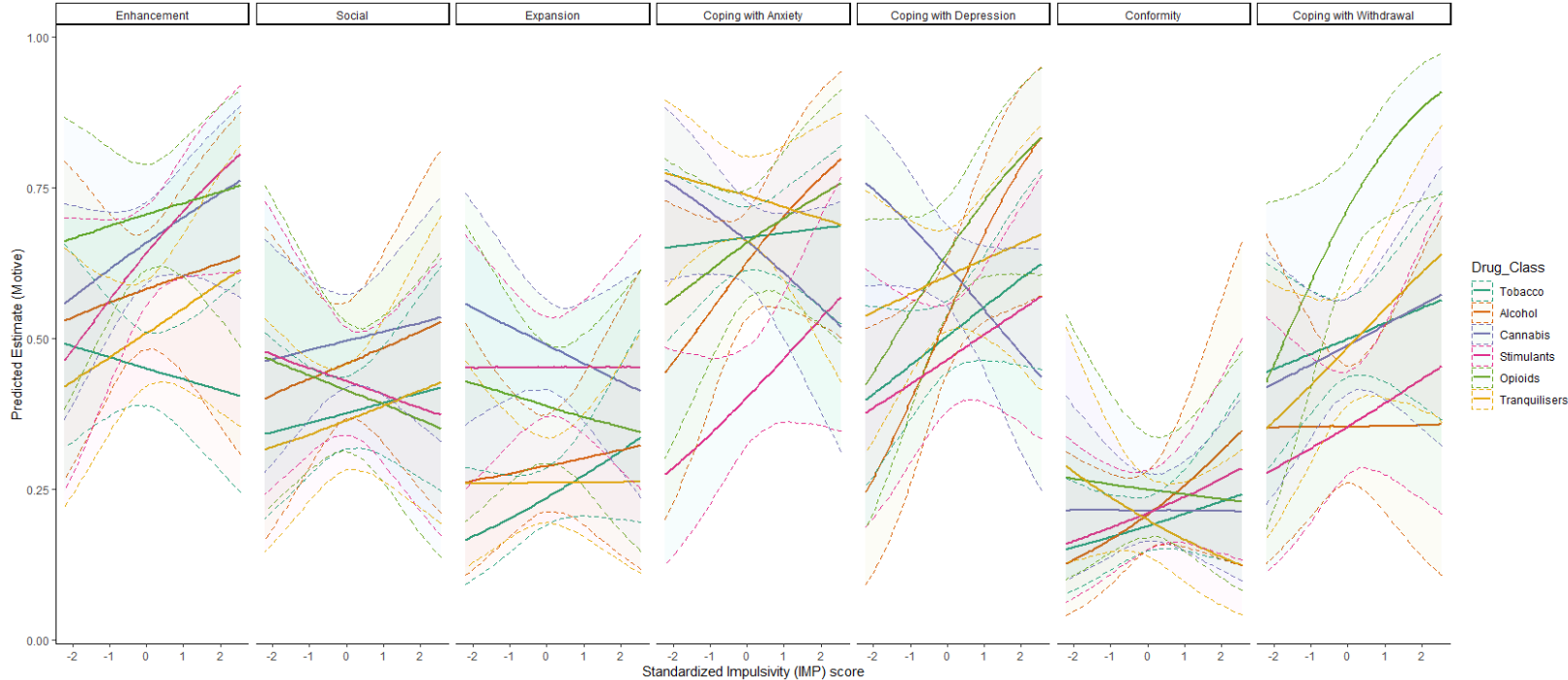
Note. SS = Sensation-Seeking. IMP = Impulsivity. HOP = Hopelessness. AS = Anxiety-Sensitivity. This plot shows the posterior distributions of all interaction effects, showing the spread of possible parameter values. Black line represents the 95% credible interval, and the dot shows the median and most credible effect.

Study 2B Figure 2. Sensation-Seeking and Drug Class Interactions



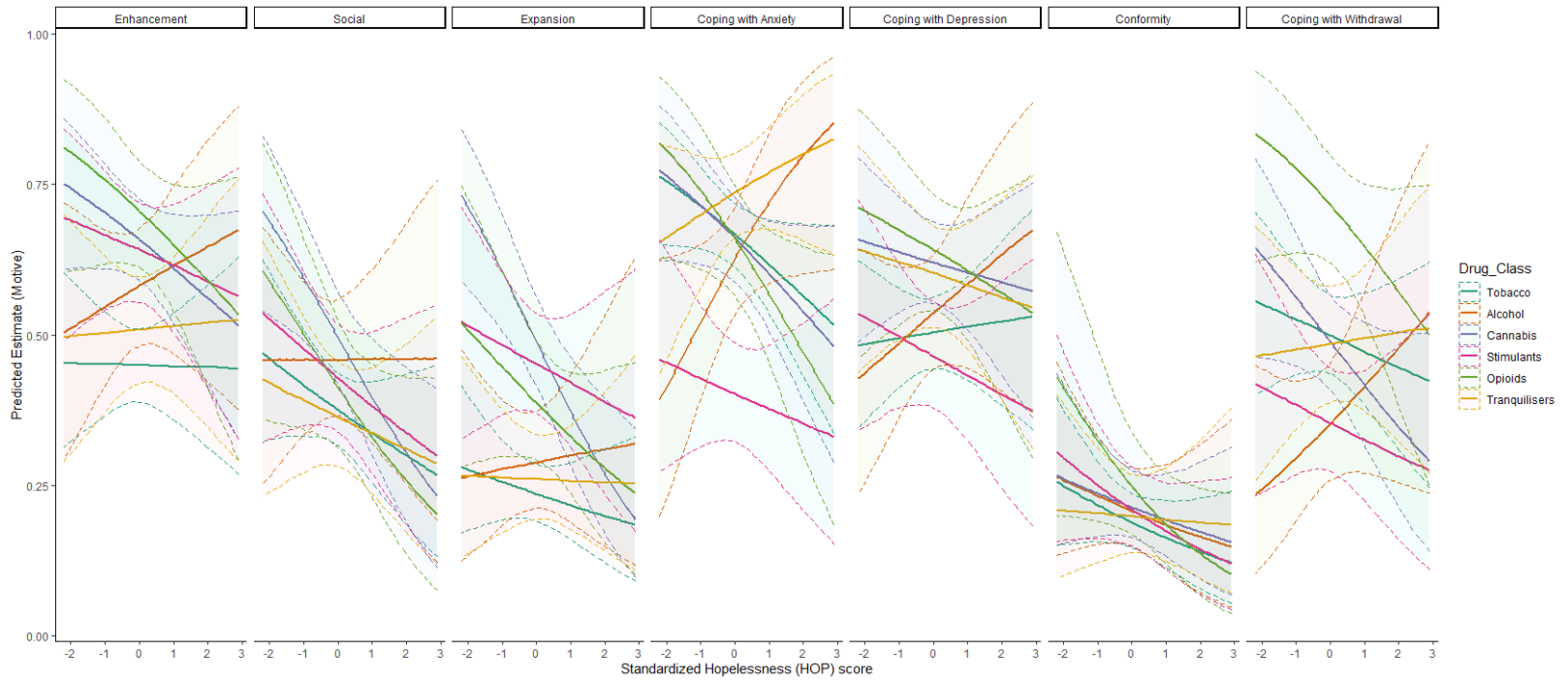
Note. The slope of each drug class is plotted along with 95% Credible Intervals.

Study 2B Figure 3. Impulsivity and Drug Class Interactions



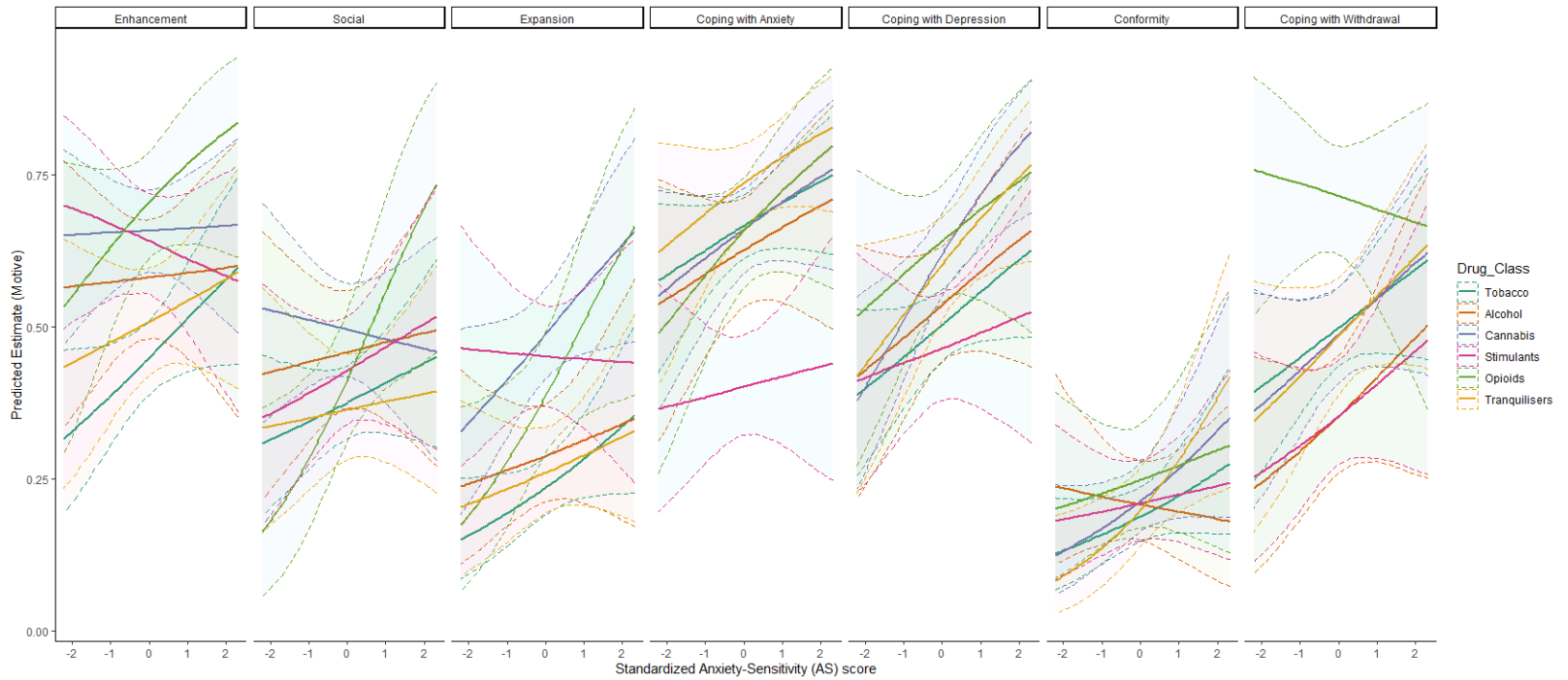
Note. The slope of each drug class is plotted along with 95% Credible Intervals.

Study 2B Figure 4. Hopelessness and Drug Class Interactions



Note. The slope of each drug class is plotted along with 95% Credible Intervals.

Study 2B Figure 5. Anxiety-Sensitivity and Drug Class Interactions



Note. The slope of each drug class is plotted along with 95% Credible Intervals.

Online Supplementary Tables

Study 2B Table 1S. (excel file)

Study 2B Table 2S. (excel file)

Study 2B Table 3S. Personality by Drug Class Interaction Slopes for Enhancement
Motives

Drug_Class	Personality	Estimate	Est.Error	CI.Lower	CI.Upper	Post.Pos	Post.Neg
Main Effects	SS	-0.02	0.09	-0.16	0.12	0.39	0.61
Tobacco	SS	-0.08	0.13	-0.30	0.14	0.28	0.72
Alcohol	SS	-0.16	0.22	-0.51	0.21	0.24	0.76
Cannabis	SS	-0.10	0.15	-0.36	0.15	0.27	0.73
Stimulants	SS	-0.10	0.20	-0.43	0.23	0.31	0.69
Opioids	SS	0.13	0.26	-0.30	0.56	0.69	0.31
Tranquilisers	SS*	0.39	0.21	0.03	0.72	0.96	0.04
Main Effects	IMP	0.13	0.09	-0.02	0.29	0.93	0.07
Tobacco	IMP	-0.07	0.15	-0.31	0.18	0.31	0.69
Alcohol	IMP	0.09	0.26	-0.34	0.51	0.64	0.36
Cannabis	IMP	0.20	0.16	-0.07	0.47	0.88	0.12
Stimulants	IMP*	0.33	0.20	0.01	0.65	0.95	0.05
Opioids	IMP	0.09	0.24	-0.29	0.48	0.66	0.34
Tranquilisers	IMP	0.16	0.20	-0.16	0.49	0.79	0.21
Main Effects	HOP	-0.08	0.08	-0.21	0.06	0.17	0.83
Tobacco	HOP	-0.01	0.13	-0.22	0.20	0.48	0.52
Alcohol	HOP	0.14	0.20	-0.19	0.47	0.76	0.24
Cannabis	HOP	-0.21	0.14	-0.43	0.02	0.07	0.93
Stimulants	HOP	-0.11	0.17	-0.39	0.17	0.26	0.74
Opioids	HOP	-0.26	0.19	-0.57	0.05	0.09	0.91
Tranquilisers	HOP	0.02	0.18	-0.26	0.32	0.55	0.45
Main Effects	AS	0.10	0.08	-0.03	0.24	0.90	0.10
Tobacco	AS*	0.26	0.14	0.05	0.49	0.98	0.02
Alcohol	AS	0.03	0.20	-0.30	0.37	0.56	0.44
Cannabis	AS	0.02	0.15	-0.22	0.27	0.55	0.45
Stimulants	AS	-0.12	0.18	-0.42	0.17	0.24	0.76
Opioids	AS	0.33	0.23	-0.05	0.71	0.93	0.07
Tranquilisers	AS	0.14	0.17	-0.14	0.42	0.80	0.20

Note. SS = Sensation-Seeking. IMP = Impulsivity. HOP = Hopelessness. AS = Anxiety-Sensitivity. Post.Pos = Probability that the slope is positive. Post.Neg = Probability that the slope is negative. * = Zero is not included in the 95% credible interval.

Study 2B Table 4S. Personality by Drug Class Interaction Slopes for Social Motives

Drug_Class	Personality	Estimate	Est.Error	CI.Lower	CI.Upper	Post.Pos	Post.Neg
Main Effects	SS	0.10	0.09	-0.04	0.25	0.88	0.12
Tobacco	SS*	0.22	0.13	0.00	0.44	0.95	0.05
Alcohol	SS	-0.02	0.22	-0.38	0.33	0.47	0.53
Cannabis	SS	-0.04	0.16	-0.30	0.23	0.40	0.60
Stimulants	SS	0.00	0.22	-0.37	0.36	0.50	0.50
Opioids	SS	0.22	0.26	-0.21	0.66	0.80	0.20
Tranquilisers	SS	0.06	0.22	-0.30	0.42	0.60	0.40
Main Effects	IMP	0.04	0.10	-0.12	0.20	0.67	0.33
Tobacco	IMP	0.07	0.15	-0.17	0.32	0.67	0.33
Alcohol	IMP	0.10	0.26	-0.32	0.53	0.66	0.34
Cannabis	IMP	0.06	0.17	-0.22	0.34	0.64	0.36
Stimulants	IMP	-0.09	0.21	-0.44	0.26	0.33	0.67
Opioids	IMP	-0.10	0.24	-0.50	0.30	0.34	0.66
Tranquilisers	IMP	0.10	0.21	-0.24	0.45	0.69	0.31
Main Effects	HOP*	-0.21	0.08	-0.35	-0.07	0.00	1.00
Tobacco	HOP	-0.18	0.14	-0.41	0.05	0.10	0.90
Alcohol	HOP	0.00	0.20	-0.33	0.35	0.50	0.50
Cannabis	HOP*	-0.41	0.14	-0.64	-0.17	0.00	1.00
Stimulants	HOP	-0.20	0.18	-0.49	0.10	0.14	0.86
Opioids	HOP*	-0.36	0.20	-0.68	-0.03	0.03	0.97
Tranquilisers	HOP	-0.12	0.18	-0.42	0.17	0.25	0.75
Main Effects	AS	0.12	0.09	-0.03	0.26	0.91	0.09
Tobacco	AS	0.14	0.13	-0.08	0.36	0.84	0.16
Alcohol	AS	0.06	0.20	-0.26	0.39	0.62	0.38
Cannabis	AS	-0.06	0.16	-0.32	0.20	0.34	0.66
Stimulants	AS	0.15	0.19	-0.15	0.47	0.80	0.20
Opioids	AS*	0.59	0.24	0.20	0.99	0.99	0.01
Tranquilisers	AS	0.06	0.18	-0.24	0.36	0.62	0.38

Note. SS = Sensation-Seeking. IMP = Impulsivity. HOP = Hopelessness. AS = Anxiety-Sensitivity. Post.Pos = Probability that the slope is positive. Post.Neg = Probability that the slope is negative. * = Zero is not included in the 95% credible interval.

Study 2B Table 5S. Personality by Drug Class Interaction Slopes for Expansion Motives

Drug_Class	Personality	Estimate	Est.Error	CI.Lower	CI.Upper	Post.Pos	Post.Neg
Main Effect	SS	-0.04	0.08	-0.18	0.10	0.31	0.69
Tobacco	SS	-0.10	0.14	-0.33	0.12	0.23	0.77
Alcohol	SS	0.05	0.21	-0.30	0.40	0.60	0.40
Cannabis	SS	0.06	0.16	-0.20	0.32	0.65	0.35
Stimulants	SS	-0.22	0.22	-0.58	0.13	0.16	0.84
Opioids	SS	0.01	0.23	-0.37	0.40	0.52	0.48
Tranquilisers	SS	-0.01	0.20	-0.34	0.34	0.48	0.52
Main Effect	IMP	0.03	0.08	-0.10	0.17	0.66	0.34
Tobacco	IMP	0.20	0.14	-0.04	0.43	0.92	0.08
Alcohol	IMP	0.06	0.24	-0.34	0.45	0.61	0.39
Cannabis	IMP	-0.12	0.17	-0.40	0.15	0.23	0.77
Stimulants	IMP	0.00	0.18	-0.30	0.30	0.50	0.50
Opioids	IMP	-0.07	0.22	-0.43	0.29	0.36	0.64
Tranquilisers	IMP	0.01	0.20	-0.31	0.33	0.50	0.50
Main Effect	HOP*	-0.16	0.08	-0.29	-0.04	0.01	0.99
Tobacco	HOP	-0.11	0.13	-0.32	0.11	0.20	0.80
Alcohol	HOP	0.05	0.20	-0.28	0.39	0.60	0.40
Cannabis	HOP*	-0.48	0.13	-0.70	-0.26	0.00	1.00
Stimulants	HOP	-0.13	0.17	-0.40	0.15	0.23	0.77
Opioids	HOP	-0.25	0.18	-0.55	0.05	0.08	0.92
Tranquilisers	HOP	-0.01	0.17	-0.30	0.27	0.47	0.53
Main Effect	AS*	0.20	0.08	0.07	0.33	0.99	0.01
Tobacco	AS*	0.25	0.13	0.04	0.47	0.97	0.03
Alcohol	AS	0.12	0.19	-0.19	0.43	0.74	0.26
Cannabis	AS*	0.30	0.16	0.05	0.56	0.98	0.02
Stimulants	AS	-0.02	0.17	-0.31	0.27	0.45	0.55
Opioids	AS*	0.50	0.23	0.12	0.88	0.99	0.01
Tranquilisers	AS	0.15	0.18	-0.14	0.44	0.80	0.20

Note. SS = Sensation-Seeking. IMP = Impulsivity. HOP = Hopelessness. AS = Anxiety-Sensitivity. Post.Pos = Probability that the slope is positive. Post.Neg = Probability that the slope is negative. * = Zero is not included in the 95% credible interval.

Study 2B Table 6S. Personality by Drug Class Interaction Slopes for Coping with Anxiety Motives

Drug_Class	Personality	Estimate	Est.Error	CI.Lower	CI.Upper	Post.Pos	Post.Neg
Main Effect	SS	0.01	0.08	-0.13	0.15	0.54	0.46
Tobacco	SS	-0.08	0.13	-0.29	0.12	0.26	0.74
Alcohol	SS	0.02	0.20	-0.32	0.35	0.55	0.45
Cannabis	SS	0.15	0.15	-0.10	0.39	0.84	0.16
Stimulants	SS	-0.19	0.22	-0.55	0.16	0.18	0.82
Opioids	SS	-0.21	0.25	-0.62	0.20	0.21	0.79
Tranquilisers	SS	0.32	0.20	-0.02	0.65	0.94	0.06
Main Effect	IMP	0.07	0.09	-0.07	0.22	0.80	0.20
Tobacco	IMP	0.03	0.14	-0.19	0.26	0.59	0.41
Alcohol	IMP	0.33	0.26	-0.10	0.76	0.90	0.10
Cannabis	IMP	-0.23	0.17	-0.51	0.04	0.09	0.91
Stimulants	IMP	0.27	0.19	-0.04	0.57	0.92	0.08
Opioids	IMP	0.19	0.23	-0.19	0.57	0.80	0.20
Tranquilisers	IMP	-0.09	0.20	-0.42	0.24	0.32	0.68
Main Effect	HOP	-0.09	0.08	-0.22	0.03	0.12	0.88
Tobacco	HOP*	-0.22	0.12	-0.42	-0.03	0.03	0.97
Alcohol	HOP*	0.43	0.22	0.08	0.81	0.98	0.02
Cannabis	HOP*	-0.26	0.14	-0.49	-0.02	0.04	0.96
Stimulants	HOP	-0.11	0.17	-0.38	0.16	0.26	0.74
Opioids	HOP*	-0.39	0.19	-0.70	-0.08	0.02	0.98
Tranquilisers	HOP	0.18	0.18	-0.10	0.49	0.84	0.16
Main Effect	AS*	0.16	0.08	0.03	0.29	0.98	0.02
Tobacco	AS	0.18	0.13	-0.03	0.39	0.92	0.08
Alcohol	AS	0.17	0.19	-0.14	0.48	0.81	0.19
Cannabis	AS	0.21	0.16	-0.05	0.47	0.91	0.09
Stimulants	AS	0.07	0.18	-0.22	0.36	0.65	0.35
Opioids	AS	0.31	0.22	-0.06	0.68	0.92	0.08
Tranquilisers	AS	0.24	0.17	-0.04	0.52	0.91	0.09

Note. SS = Sensation-Seeking. IMP = Impulsivity. HOP = Hopelessness. AS = Anxiety-Sensitivity. Post.Pos = Probability that the slope is positive. Post.Neg = Probability that the slope is negative. * = Zero is not included in the 95% credible interval.

Study 2B Table 7S. Personality by Drug Class Interaction Slopes for Coping with Depression Motives

Drug_Class	Personality	Estimate	Est.Error	CI.Lower	CI.Upper	Post.Pos	Post.Neg
Main Effect	SS	0.06	0.08	-0.07	0.19	0.76	0.23
Tobacco	SS	-0.01	0.13	-0.23	0.21	0.46	0.54
Alcohol	SS	0.19	0.23	-0.19	0.58	0.79	0.21
Cannabis	SS	0.21	0.15	-0.04	0.45	0.92	0.08
Stimulants	SS	-0.14	0.21	-0.49	0.21	0.26	0.74
Opioids	SS	-0.20	0.25	-0.61	0.21	0.21	0.79
Tranquilisers	SS	0.31	0.20	-0.02	0.64	0.94	0.06
Main Effect	IMP*	0.14	0.09	0.00	0.28	0.95	0.05
Tobacco	IMP	0.20	0.14	-0.03	0.43	0.92	0.08
Alcohol	IMP*	0.57	0.26	0.14	0.99	0.99	0.01
Cannabis	IMP*	-0.29	0.17	-0.56	-0.02	0.04	0.96
Stimulants	IMP	0.16	0.20	-0.16	0.48	0.80	0.20
Opioids	IMP*	0.41	0.24	0.02	0.81	0.96	0.04
Tranquilisers	IMP	0.12	0.20	-0.21	0.44	0.72	0.28
Main Effect	HOP	0.00	0.08	-0.13	0.12	0.50	0.50
Tobacco	HOP	0.04	0.13	-0.16	0.24	0.62	0.38
Alcohol	HOP	0.20	0.20	-0.13	0.54	0.84	0.16
Cannabis	HOP	-0.07	0.14	-0.30	0.16	0.30	0.70
Stimulants	HOP	-0.13	0.17	-0.40	0.15	0.22	0.78
Opioids	HOP	-0.15	0.19	-0.46	0.17	0.22	0.78
Tranquilisers	HOP	-0.08	0.17	-0.36	0.19	0.33	0.67
Main Effect	AS*	0.24	0.08	0.12	0.37	1.00	0.00
Tobacco	AS*	0.22	0.12	0.02	0.42	0.96	0.04
Alcohol	AS	0.22	0.19	-0.09	0.54	0.88	0.12
Cannabis	AS*	0.44	0.15	0.21	0.69	1.00	0.00
Stimulants	AS	0.10	0.18	-0.20	0.39	0.72	0.28
Opioids	AS	0.23	0.23	-0.15	0.61	0.85	0.15
Tranquilisers	AS*	0.33	0.17	0.06	0.61	0.98	0.02

Note. SS = Sensation-Seeking. IMP = Impulsivity. HOP = Hopelessness. AS = Anxiety-Sensitivity. Post.Pos = Probability that the slope is positive. Post.Neg = Probability that the slope is negative. * = Zero is not included in the 95% credible interval.

Study 2B Table 8S. Personality by Drug Class Interaction Slopes for Conformity Motives

Drug_Class	Personality	Estimate	Est.Error	CI.Lower	CI.Upper	Post.Pos	Post.Neg
Main Effect	SS	0.15	0.10	-0.02	0.30	0.93	0.07
Tobacco	SS	0.08	0.15	-0.16	0.32	0.69	0.31
Alcohol	SS	0.20	0.22	-0.17	0.56	0.82	0.18
Cannabis	SS	0.21	0.17	-0.07	0.49	0.90	0.10
Stimulants	SS	0.05	0.20	-0.27	0.39	0.60	0.40
Opioids	SS	0.17	0.24	-0.23	0.57	0.77	0.23
Tranquilisers	SS*	0.41	0.22	0.04	0.78	0.97	0.03
Main Effect	IMP	0.05	0.10	-0.12	0.21	0.70	0.30
Tobacco	IMP	0.13	0.16	-0.13	0.38	0.79	0.21
Alcohol	IMP	0.28	0.26	-0.14	0.71	0.86	0.14
Cannabis	IMP	0.00	0.18	-0.30	0.31	0.50	0.50
Stimulants	IMP	0.16	0.19	-0.16	0.47	0.79	0.21
Opioids	IMP	-0.05	0.23	-0.43	0.33	0.42	0.58
Tranquilisers	IMP	-0.22	0.22	-0.58	0.13	0.15	0.85
Main Effect	HOP*	-0.17	0.09	-0.32	-0.03	0.03	0.97
Tobacco	HOP	-0.18	0.14	-0.41	0.05	0.10	0.90
Alcohol	HOP	-0.15	0.19	-0.47	0.16	0.22	0.78
Cannabis	HOP	-0.13	0.15	-0.38	0.11	0.19	0.81
Stimulants	HOP	-0.23	0.17	-0.52	0.05	0.09	0.91
Opioids	HOP*	-0.37	0.19	-0.68	-0.06	0.03	0.97
Tranquilisers	HOP	-0.03	0.18	-0.33	0.25	0.44	0.56
Main Effect	AS*	0.18	0.09	0.03	0.33	0.97	0.03
Tobacco	AS	0.21	0.14	-0.01	0.45	0.94	0.06
Alcohol	AS	-0.08	0.19	-0.40	0.25	0.35	0.65
Cannabis	AS*	0.29	0.17	0.01	0.57	0.96	0.04
Stimulants	AS	0.08	0.17	-0.20	0.37	0.69	0.31
Opioids	AS	0.12	0.21	-0.21	0.47	0.72	0.28
Tranquilisers	AS*	0.46	0.19	0.15	0.78	0.99	0.01

Note. SS = Sensation-Seeking. IMP = Impulsivity. HOP = Hopelessness. AS = Anxiety-Sensitivity. Post.Pos = Probability that the slope is positive. Post.Neg = Probability that the slope is negative. * = Zero is not included in the 95% credible interval.

Study 2B Table 9S. Personality by Drug Class Interaction Slopes for Coping with Withdrawal Motives

Drug_Class	Personality	Estimate	Est.Error	CI.Lower	CI.Upper	Post.Pos	Post.Neg
Main Effect	SS	0.07	0.10	-0.09	0.23	0.77	0.23
Tobacco	SS	0.04	0.14	-0.20	0.27	0.60	0.40
Alcohol	SS*	0.54	0.25	0.14	0.95	0.99	0.01
Cannabis	SS	0.00	0.17	-0.27	0.29	0.51	0.49
Stimulants	SS	-0.34	0.23	-0.73	0.04	0.07	0.93
Opioids	SS	0.14	0.26	-0.29	0.56	0.71	0.29
Tranquilisers	SS	0.28	0.23	-0.09	0.65	0.89	0.11
Main Effect	IMP*	0.18	0.10	0.01	0.35	0.96	0.04
Tobacco	IMP	0.10	0.16	-0.15	0.36	0.74	0.26
Alcohol	IMP	0.00	0.29	-0.47	0.46	0.51	0.49
Cannabis	IMP	0.13	0.20	-0.19	0.45	0.75	0.25
Stimulants	IMP	0.16	0.23	-0.20	0.53	0.76	0.24
Opioids	IMP*	0.55	0.25	0.13	0.96	0.98	0.02
Tranquilisers	IMP	0.25	0.22	-0.10	0.62	0.88	0.12
Main Effect	HOP	-0.10	0.09	-0.24	0.04	0.12	0.88
Tobacco	HOP	-0.10	0.14	-0.32	0.11	0.22	0.78
Alcohol	HOP	0.26	0.22	-0.09	0.62	0.88	0.12
Cannabis	HOP	-0.29	0.15	-0.54	-0.04	0.03	0.97
Stimulants	HOP	-0.13	0.18	-0.43	0.17	0.24	0.76
Opioids	HOP	-0.32	0.20	-0.65	0.01	0.06	0.94
Tranquilisers	HOP	0.04	0.18	-0.26	0.33	0.59	0.41
Main Effect	AS*	0.18	0.09	0.03	0.34	0.98	0.02
Tobacco	AS	0.20	0.14	-0.03	0.44	0.92	0.08
Alcohol	AS	0.27	0.22	-0.09	0.64	0.89	0.11
Cannabis	AS	0.23	0.17	-0.04	0.50	0.92	0.08
Stimulants	AS	0.22	0.20	-0.10	0.54	0.87	0.13
Opioids	AS	-0.11	0.25	-0.52	0.28	0.34	0.66
Tranquilisers	AS	0.27	0.19	-0.04	0.58	0.93	0.07

Note. SS = Sensation-Seeking. IMP = Impulsivity. HOP = Hopelessness. AS = Anxiety-Sensitivity. Post.Pos = Probability that the slope is positive. Post.Neg = Probability that the slope is negative. * = Zero is not included in the 95% credible interval.

CHAPTER 7. TRANSITION FROM STUDY 2 TO 3

One of the strengths of the four-factor personality model (Castellanos-Ryan & Conrod, 2012; Conrod, Pihl, et al., 2000) is that it directly informs treatment recommendations. The focus on personality and motives led to the development of personality-targeted interventions, such as the PreVenture programme. PreVenture is a brief, manualized group treatment protocol that is currently used as a preventative intervention with teens; it has been shown in multiple randomized clinical trials to be effective at reducing or preventing substance use and improve mental health outcomes in at risk youth (Conrod, 2016). The remarkable efficacy of this approach in youth, despite only requiring two 90-minute sessions, impressed upon us that a relatively brief personality-targeted approach may also be effective as a psychosocial supplement to MMT (Stewart et al., 2018), which was the most common form of opioid agonist therapy in Canada at the time. Of course, this would only be true if the theoretical basis of the four-factor personality model was supported in a population at a later stage of addiction, which informed our quantitative research questions regarding the link between personality, substance use, and motives for use presented in the preceding chapters of this dissertation.

Early on in this research project, we conducted focus groups with four different MMT providers and individual interviews with MMT clients, where we explicitly presented the Four-Factor Personality Vulnerability model and collected feedback on adapting existing PreVenture manuals and the format of the intervention to conform to the unique needs of the MMT population (Mahu, Conrod, Barrett, MacIsaac, et al., 2019;

see Appendix G for conference slides). Both MMT providers and clients expressed interest in adapting PreVenture to the MMT context; however, all agreed that revisions to the manuals and session format would need to be made to reflect the reality of the MMT population more accurately. For example, specific recommendations were made around adapting the visuals in the manual to reflect adult contexts, briefly discussing the impact of trauma, adding some relapse prevention, having shorter but more numerous sessions, and taking a client-centered approach regarding desired outcomes. Part of this work also involved interviewing 20 MMT clients scoring high on one of the four SURPS traits and collecting information on how their personality manifested in their life; this piece of work comprises the final study in my dissertation.

PreVenture manuals are structured such that there is a different manual specific to each personality group (as group sessions are organized by high-risk SURPS personality trait). An important role of these manuals is to facilitate goal setting, help clients explore their personality trait, and learn new, more adaptive, ways of coping that align with each trait's individual cognitive, affective, and behavioral vulnerabilities. Thus, there is a psychoeducational component (i.e., exploring what the personality trait is, and teaching a range of cognitive-behavioral strategies), introduced through multiple "scenarios" derived from stories collected by qualitative interviews with youth (in PreVenture) scoring high on that personality trait. These scenarios are rich in personality-specific problems and coping styles (e.g., they may reflect: an SS youth who struggles with boredom and feels compelled to engage in some risky activity; an IMP youth who misinterprets a neutral situation as threatening and responds with aggression; an AS youth who worries about an upcoming social situation and finds themselves

catastrophizing about their internal physiology; or a HOP youth who interprets interpersonal interactions as negative, engages in self-criticism, and withdraws). An adaptation of this protocol to the MMT context requires collection of relevant stories that discuss not only adult problems, but also problems that may be particularly salient to MMT clients (e.g., polysubstance use, addiction, methadone barriers, stigma, crime, housing and employment insecurity). It is thus important to consult with relevant stakeholders to enhance contextual and cultural relevance (Movsisyan et al., 2021). This will allow for a better understanding of how the cognitive-behavioral model may apply within each personality profile across various scenarios.

PreVenture has been adapted to conform to specific cultural contexts among different populations of youth. Although initially developed in the UK, more recent cultural adaptations have been made for Canadian and Australian contexts, and typically employed qualitative methodology (E. L. Barrett et al., 2015). More recently, PreVenture is being adapted and tested among university students (Stewart et al., 2022). While Study 1 and 2 have demonstrated links between personality, motives, and use of various substances through quantitative analyses, Study 3 examines the lived experience of these personality traits using thematic analysis (Braun & Clarke, 2006) and content analysis (Elo & Kyngäs, 2008) among MMT clients. The first objective of this third study is to unearth relevant information for the development of culturally sensitive and contextually relevant scenarios for future manuals. Second, these findings have the potential to extend the literature on the four-factor personality vulnerability model to a clinical population, using qualitative methodologies.

CHAPTER 8. STUDY 3A: THE FOUR-FACTOR PERSONALITY MODEL AND ITS QUALITATIVE CORRELATES AMONG METHADONE MAINTENANCE THERAPY (MMT) CLIENTS

The manuscript prepared below includes this study. Under the supervision of Dr. Sherry Stewart, I developed the research questions and hypotheses, completed a portion of the qualitative interviews conducted in Nova Scotia, prepared the dataset for analysis, conducted the analyses, and interpreted the study findings. I wrote the initial draft of the manuscript; then incorporated one round of feedback from Dr. Stewart. This manuscript is currently being prepared for publication. The full working reference is as follows:

Mahu, I.T., Conrod, P. J., Barrett, S. P., Swansburg, J., Sako, A., & Stewart, S. H.

(unpublished). The Four-Factor Personality Model and its qualitative correlates among Methadone Maintenance Therapy (MMT) clients.

Manuscript in preparation for submission.

Abstract

Background: The Four Factor Personality Vulnerability model (Castellanos-Ryan & Conrod, 2012) identifies four specific personality traits (e.g., sensation seeking [SS], impulsivity [IMP], anxiety sensitivity [AS], and hopelessness [HOP]) as implicated in substance use behaviours, motives for substance use, and co-occurring psychiatric conditions. Although the relationship between these traits and substance use in methadone maintenance therapy (MMT) clients has been investigated quantitatively, to date no study has examined the qualitative expression of each of these traits using clients' voice. **Method:** 20 MMT clients (65% male, 80% white, mean age[SD] = 42.06 [10.20]) scoring high on one of the four personality profiles measured by the Substance Use Risk Profile Scale (SURPS; Woicik et al., 2009) completed a semi-structured qualitative interview designed to explore their lived experience with each respective trait. Thematic analysis (Braun & Clarke, 2006) was used to derive themes, which were further quantified using content analysis (Elo & Kyngäs, 2008). **Results:** Themes emerging from interviews reflected (1) internalizing and externalizing symptoms, (2) adversity experiences, and (3) substance use. Internalizing symptoms subthemes included symptoms of anxiety, fear, stress, depression, and avoidance coping. Externalizing subthemes included angry affect, disinhibited cognitions, anti-social behaviors, and risk-taking behaviors. Adverse experiences subthemes included poor health, poverty, homelessness, unemployment, trauma, and interpersonal conflict. Finally, substance use subthemes include substance type, methods of use, and substance use motives. Theoretically expected differences emerged in the relative endorsement of various subthemes between personality profiles. **Conclusion:** Personality is associated with

unique cognitive, affective, and behavioral profiles and lived experiences, suggesting that personality may be a novel intervention target in adjunctive psychosocial treatment for those undergoing MMT.

Introduction

Now in its third wave, the opioid epidemic continues to cause havoc and destruction for individuals, families, and communities (Mattson et al., 2021). Opioid agonist treatment (OAT), such as methadone maintenance therapy (MMT) or buprenorphine/naloxone, has been extensively shown to be effective at reducing opioid-related harms (Connock et al., 2007; Mattick et al., 2014). Nonetheless, it is important to consider that the majority of opioid users engage in polysubstance use (Crummy et al., 2020), contributing to a more complicated clinical profile that is not always fully addressed by OAT alone. Indeed, the clinical profile typical of opioid users includes not only polysubstance use (Cicero et al., 2020), but also high rates of trauma exposure, poverty, criminal justice system involvement (Darke & Ross, 1997; Darke, 2011; Hser et al., 2015), comorbid psychopathology (Morin et al., 2020), and other comorbid health problems such as chronic pain (Darke & Ross, 1997; Darke, 2011; Hser et al., 2015). Given this increased clinical complexity, and to enhance the effectiveness of OAT, psychosocial interventions are recommended as a crucial component of treatment across several OAT clinical guidelines (Bruneau et al., 2018; Comer et al., 2015; Gowing et al., 2014; World Health Organization, 2009). A recent systematic review by Dugosh et al. (2016) largely supports the use of psychosocial interventions in the context of OAT, although the added benefit does tend to vary across medications (methadone, buprenorphine/naloxone), outcomes (e.g., illicit opioid use, treatment adherence, HIV risk, psychosocial functioning, adherence to psychiatric medication), and psychosocial intervention types. One such model could include personality-targeted interventions (e.g., “PreVenture”; Conrod, 2016). These can be brief while maintaining high levels of

efficacy due to their targeted nature, and impact on multiple outcomes, including substance use and mental health. These interventions have been used with great success among youth as a brief model but have not yet been adapted to the MMT setting.

Four-Factor Personality Model

Personality-targeted interventions are based on the four-factor personality risk model (Castellanos-Ryan & Conrod, 2012; Conrod, Pihl, et al., 2000; Pihl & Peterson, 1995), which outlines how four lower-order traits are differentially associated with substance use vulnerability through specific neurological and motivational mechanisms. These four traits include: (1) sensation-seeking (SS), defined as the preference for novel and exciting stimuli, (2) impulsivity (IMP), defined as deficits in behavioral inhibition and planning, (3) hopelessness (HOP), operationalized as depression proneness and pessimism about the future, and (4) anxiety-sensitivity (AS), defined as the fear of one's own bodily arousal sensations. Each trait is associated with preference for specific substances of abuse, motives for use (i.e., reasons for using drugs, including but not limited to: enhancement, social, conformity, and coping motives), and co-occurring psychiatric conditions (for a review, see Castellanos-Ryan & Conrod, 2012).

Recent work by our group has explored the impact of these high-risk personality traits on substance use (Mahu, Conrod, Barrett, Sako, et al., 2019 - Chapter 2) and substance use motives (Mahu et al., 2021 - Chapter 6) among MMT clients, providing emerging evidence that personality may be a suitable target for focused intervention. For example, SS was associated with past 30-day use of alcohol, cannabis, and stimulants (Mahu, Conrod, Barrett, Sako, et al., 2019 - Chapter 2). SS was associated with enhancement motives for tranquilisers, social motives for tobacco, and coping-with-

withdrawal motives for alcohol (Mahu et al., in preparation – Chapter 6). IMP was associated with past 30-day injection drug use (Mahu, Conrod, Barrett, Sako, et al., 2019 - Chapter 2). IMP was associated with enhancement motives for stimulants, coping-with-withdrawal motives for opioids, and coping-with-depression motives for alcohol and opioids (Mahu et al., in preparation – Chapter 6). HOP was associated with past 30-day opioid and tranquiliser use (Mahu, Conrod, Barrett, Sako, et al., 2019 - Chapter 2). HOP was associated with coping-with-anxiety motives for alcohol (Mahu et al., in preparation – Chapter 6). Finally, AS was associated with past 30-day tranquiliser use (Mahu, Conrod, Barrett, Sako, et al., 2019 - Chapter 2). AS was associated with coping-with-anxiety and coping-with-withdrawal motives for tranquilisers and tobacco (Mahu et al., in preparation – Chapter 6).

Although we have some evidence that personality is implicated in the maintenance of addictive behaviour among MMT clients, adapting existing personality-targeted interventions to the MMT setting requires a more nuanced understanding of the ways in which personality relates to polysubstance use in this population. This is necessary not only to adapt the theoretical underpinnings of the four-factor model to this new population, but also to design appropriate intervention materials (e.g., treatment manuals) and identify potential intervention outcomes beyond reducing substance use. Consequently, this study was designed to address this gap using qualitative methodology, aimed at gaining a better understanding of how personality traits from the four-factor model are expressed in relation to high-risk behaviours among MMT clients. Qualitative methodologies allow for the extraction of “themes” from coded interview data. We were specifically interested in learning more about how each of the four high-risk personality

traits is expressed cognitively, affectively, and behaviourally in relation to various lived experiences and how these experiences relate to substance use motives and behaviors among a sample of high personality risk MMT clients. We were also interested in the relative endorsement of each theme within each specific personality profile.

Methods

Participants

Twenty OAT clients that took part in a previous quantitative study (Mahu et al., 2021; Mahu, Conrod, Barrett, Sako, et al., 2019 - Chapters 2, 4, & 6) from one of four OAT clinics in Montreal (n=2) or the Halifax Regional Municipality (n=2) were invited to take part in an in-depth semi-structured qualitative interview. Clients scoring at least one standard deviation or higher relative to the normative sample (n=138) on either one of the four personality profiles measured with the Substance Use Risk Profile Scale (SURPS; Woicik et al., 2009) were invited to participate, until five individuals were recruited for each personality profile. If participants met this criterion on more than one trait, we prioritized recruiting them for an interview in their highest relative elevation first, unless the recruitment target of five was already met for that subgroup. Due to an error at one site, an AS participant completed an IMP interview – but given that this participant was also high on IMP, their data was kept. In total, we recruited 5 HOP clients, 4 AS clients, 5 SS clients, and 6 IMP clients.

Data Collection

Semi-structured interviews lasted 60-90 minutes and were conducted in a private room at each OAT clinic by experienced interviewers (two doctoral candidates in clinical

psychology, and 1 senior research assistant). Interviews were conducted in either English (n = 17) or French (n= 3), as per participants' preference. Informed consent was obtained at the outset of the study, and participation was voluntary. Participants were informed that participation in the study would not affect their MMT treatment, and that details from the interview would remain confidential. Interviews were audio recorded for transcription and analysis purposes. Identifying information was removed from the final transcripts. Participants were compensated with \$20 CDN at the end of the interview. Ethical approval to conduct this research was obtained via each relevant hospital research ethics board in Montreal and the Halifax Regional Municipality.

The semi-structured interview guide was designed to gather information to support the eventual development of scenarios and material for a future personality targeted intervention with OAT clients. This was similar to the strategy used for developing other adaptations of the PreVenture personality-targeted intervention (e.g., E. L. Barrett et al., 2015; Mushquash et al., 2020). Briefly, we collected information regarding treatment goals, barriers, needs, and personality-specific information regarding the cognitive, affective, and behavioral experience of each personality trait. More specifically, participants were invited to describe past situations where their personality led them to experience an unfavorable outcome. Substance use and substance use motives were specifically queried if they did not emerge organically in the scenarios described. Open ended questions and more specific probes were used as necessary to obtain sufficient detail (see Appendix I for a copy of the interview guide).

Data Analysis

Completed interviews were transcribed verbatim into either English or French. The first author, who is bilingual, listened to each interview to double check that the transcriptions were accurate. Data was imported for management, coding, and analysis into NVivo Pro v. 12 (QSR International, 2021), a qualitative data analysis software package. Thematic analysis (Braun & Clarke, 2006) was used to derive codes and interpret the final themes that emerged from the data. To aid in the description and comparison of themes across personality profiles, we also employed content analysis (Elo & Kyngäs, 2008) as a secondary analytical strategy, as it allowed us to quantify and compare the endorsement of themes across different groups by counting the number of references (i.e., coded units) belonging to each theme. We then examined the relative endorsement of each theme as a percent of total references within each personality profile.

The epistemological position employed during analysis was realist/essentialist, and focused on reporting the experiences, meaning, and reality of participants. Initial codes were derived by the first author (ITM), a senior doctoral candidate in clinical psychology. ITM has nine years of research experience with the four-factor personality model in the context of addiction, knowledge of the OAT population, and over six years of supervised clinical training (>1500 hours) in cognitive-behavioral assessment and therapy. Coding focused primarily on semantic content (i.e., explicit, surface meaning in text), unless the data provided strong contextual evidence of an implicit meaning. Additionally, we used a combination of both deductive and inductive coding strategies. For example, initial codes were deductive, and informed by the structure of the interview guide and the framework of the cognitive behavioral model (i.e., separating thoughts,

behaviours, and affect, within the context of triggering situations). However, other codes emerged inductively through familiarization with the data. Codes and themes were collaboratively revised amongst the authors until consensus was reached. Following a variety of revisions, final codes were organized into themes (n = 28; collection of thematically similar codes) and theme families (n = 3, collection of similar themes) based on the initial research question and the authors' combined clinical and research experience with personality, addiction, and psychopathology.

Results

Participant demographics are reported in Table 1. Three primary theme families emerged from the interviews, which included (1) internalizing and externalizing symptoms, (2) adversity experiences, and (3) substance use.

Internalizing and Externalizing Symptoms

One of the major themes that emerged from participants' stories about their personality reflected symptoms of internalizing (i.e., anxiety, depression, avoidance) and externalizing (i.e., anger, disinhibition, thrill seeking, anti-social behaviour) forms of psychopathology. These various subthemes were expressed through coding of various affective (i.e., how they felt emotionally or physically), cognitive (i.e., how they interpreted events and how they thought in different situations), and behavioral (i.e., how they acted) processes that participants described in various situations. The internalizing symptoms included experiences of (1) anxiety, fear, or stress, (2) sadness or depression, and (3) avoidant coping behaviours. The externalizing symptoms included experiences of (4) anger or frustration, (5) disinhibited cognitions, (6) anti-social behaviours, and (7)

thrill seeking or risk taking. Table 2 depicts the distribution of total references coded for these themes within each personality profile. Each is described in more detail below.

Anxiety, Fear, or Stress

A common affective experience was general feelings of anxiety, which included discussions around feeling anxious, afraid, or stressed, experiencing panic attacks or panic symptoms, and catastrophizing about physical sensations. These descriptions often highlighted symptoms of a panic attack. For example, one participant described his panic attacks as follows:

*“When I start having that, and then I start, *sighs* having like, breathing starts getting like caved in and I'm like oh fuck it, and I start getting palms sweaty, feet tingling, hands start tingling and then it [heart-rate] starts going going going going going going going going” (C113, male, age 33, AS)*

Unsurprisingly, many participants described being stressed because of the multiple barriers and hardships they needed to navigate daily. These included experiencing poverty, homelessness, marginalization, and interpersonal conflict or violence. These feelings of stress were closely related to substance use, often leading to substance use as a form of coping, as explained by one participant: *“the main reason I smoke marijuana now too ...at-you know three, four grams a day is a lot for just one person ... and the only reason I'm using so much right now is 'cause I'm all stressed out.”* (A105, male, age 48, IMP).

Relative to other personality profiles, descriptions of this kind were found to dominate the content of discussions within the AS interviews, occupying 55.42% of total

internal experience references coded (Table 2). Descriptions of withdrawal states were also frequently discussed among high AS MMT clients and were often connected to fear.

Sadness or Depression

Feelings of intense sadness, depression, loneliness, negative self-talk, regrets, guilt, and suicidal or self-injurious behaviour were combined to reflect an internal experience of sadness or depression. For some, these feelings were connected to situations in which they experienced a great loss or some other major life stressor, and were often directly followed by substance use as a means of coping:

“Lost, lost the kids. She didn't want me to know where they were. Who had them, and, so yeah... Uhm, took a toll on me. I, I lost it. I didn't want to answer the door to nobody. I didn't want no one around me. And, uh, my daughter's mom, she had gotten an apartment in town and moved out of my house and of course I locked myself in my home. For, thirty some days and... Drink, started doing drugs, and um, led to other drugs.” (A154, male, age 43, IMP)

For others, this theme was evident in descriptions containing negative self-talk or rumination.

“Yeah, and-and that's where I get depressed some-sometimes because I did it to myself, right? Nobody did it to me, nobody made me do any of the things that I did so that plays a big thing in the back of your head, like you're an idiot, why'd you even do that? Look what you had, what you don't have, look at what happened, this and that and um you know, you still choose to do it again” (A118, male, age 42, HOP)

Some participants expressed regret or remorse about past behaviour or events, particularly when the consequences were severe and resulted in loss of employment, relationships, and/or opportunities. Participants described making bad decisions in the moment, without considering the potential consequences, but with time realizing the cost of their actions and experiencing regret over “what could have been”.

Relative to other personality groups, this theme was particularly prominent among the internal experiences of HOP interviews, occupying 54.05% of total references coded in this group (Table 2).

Avoidant Coping Behaviors

Avoidance, distraction, safety-behaviours, thought suppression, and interpersonal withdrawal as means of coping with heightened anxiety or other distressing emotional states comprised a subtheme indexing a variety of avoidant coping behaviours.

“It's just reading, it's just like taking my focus away from everything around me or whatever is, is making me anxious and just kind of like um, just kinda like having something to like focus on. Like I'll even just like don't matter what's in my purse if there's anything to read, even if it's like a grocery list, I can just read it like for that few minutes just to make my head go back, to like make my mind go back.” (A202, female, age 26, AS)

These strategies were frequently discussed by those in the AS group (20.48%), particularly for coping with anxiety and panic attacks (Table 2).

Anger or Frustration

Anger was an emotion often endorsed in relation to dealing with conflict, loss, poverty, or marginalization. For example, a participant described his frustration with accessing pain medications for a painful surgery when the system labelled him as an addict, explaining:

*“We [doctors] don't prescribe them to people like you anymore. *laughs* To give them to me for years and then they tell me they can't, I can't have anymore? That's when I get in trouble, that's when I have a problem, and that is why I have such a deep-seated hate for the medical society and stuff... just because of stuff they've done. You don't always get treated well in the healthcare system if you're an addict. You know, everybody else says, it's a problem because you are a problem and you're costing money to taxpayers and you're this and you're that, they don't let you forget those things easy either. So between what doctors kinda put me through and jerk me around you know I just don't like doctors and I don't like healthcare facilities and places like that very well anymore because I just don't trust them, you know.” (A105, male, age 48, IMP)*

Other participants described affective reactions of anger linked with an overall difficulty in regulating their own emotions or linked with a tendency to jump to conclusions. This sub-theme was more commonly endorsed among the high IMP interviews (9.12%) relative to the other personality traits (Table 2).

Disinhibited Cognitions

Codes reflecting a collection of cognitions (or impulses) that described a tendency to approach situations without thinking through consequences and feeling as if one has no control over their own actions, encompassed a theme of disinhibited or impulsive

cognitions. Codes within this theme often co-occurred with other externalizing symptoms, such as anger/frustration and anti-social behaviour.

“But... I mean I’ve got a very short fuse and I go from zero to five thousand in, you know, a very short time and ...I’ve always been very impatient, very...you know ...It’s just always been...it’s just been go, go, go, go, go and I seem to can’t slow down or relax or-or let myself relax, I feel like I got to be... right on edge all the time and that’s very tiring.” (A105, male, age 48, IMP)

Some participants described feeling as if they had little control over their own actions, and that their behaviors occurred quite automatically without much planning or forethought:

“Well, when it’s happening, I don’t ... it’s not a plan or anything, it just, it just happens. It’s after that I would, see any uh, any kind of plan, or anything, but not, not while. It’s automatic. I don’t know if that makes sense, but it’s automatic.”
(A103, male, 61, SS).

Relative to other personality groups, these disinhibited cognitions were commonly endorsed within the interviews with high IMP clients (21.28% of coded references; Table 2).

Anti-social Behaviours

Instances of aggression (e.g., getting into fights), committing criminal acts (e.g., stealing, armed robbery), or engaging in interpersonal deception (e.g., lying to conceal substance use) were coded under this theme. These behaviours were generally described as a desperate last-ditch attempt to acquire money or drugs, and often motivated by a desire to avoid painful and uncomfortable withdrawal sensations.

“I didn't have any money left, and I didn't have anything else left, and I had to have the drugs, I was sick. I did what I really didn't want to do [robbing a pharmacy], 'cause I knew what was gonna happen from the first one [first incarceration].” (A105, male, age 48, IMP)

Experiencing poverty was heavily tied to coded anti-social behaviours, as were descriptions of disinhibited cognitions. This theme was frequently endorsed among SS (18.75%), IMP (19.59%) and HOP (14.86%) interviews (Table 3). However, the qualitative expression of this theme differed across these three traits. Relative to the other two traits, the anti-social behaviours described in HOP interviews primarily featured coded references to deception (e.g., lying to hide information from loved ones) largely to avoid inter-personal conflict. In contrast, those in IMP interviews featured more references to aggression (i.e., being involved in fights or violent actions) and criminal activity (e.g., robberies), while those in SS interviews primarily featured references to criminal activity.

Thill Seeking or Risk Taking

This theme describes a way of interacting with the environment that is cognitively and affectively centered around chasing rewards and thrills, and behaviorally comprised of rule breaking or risk-taking behaviours.

“I uh, I always used to call it the gambler's rush. Your heart starts beating fast. your breath - your breathing starts getting heavy and that, right? Your blood pressure goes sky high.” (A103, male, 61, SS)

These behaviors often included descriptions of various high-risk (e.g., speeding, dangerous driving) and rule-breaking (e.g., cheating at cards, trespassing, vandalism)

activities that contained an element of excitement and reward. This theme was heavily endorsed within the SS interviews (41.96% of external references coded; Table 2).

Adverse Experiences

The next theme family reflected adverse experiences or situations that were frequently mentioned in various interviews. This theme was often intertwined with the previously discussed symptoms of internalizing and externalizing psychopathology, often as an antecedent or consequence. The major subthemes here included (1) Poor Health, (2) Poverty, Homelessness, and Unemployment, (3) Traumatic Experiences, and (4) Interpersonal Conflict. The endorsement of each of these subthemes by personality can be seen in Table 3. More detail on these subthemes appears next:

Poor Health

This theme included descriptions of poor physical health or chronic pain, either due to age, chance, or accidents. For some participants, managing pain was listed as a major contributor to developing an addiction in the first place: *“I started getting back to work, I got back to work and then I broke my foot. Doctor [name] put me on a couple pain medications, the next thing you know, I'm hooked on pills *participant laughs*.”* (A118, male, age 42, HOP). Relative to other adverse experiences, poor physical health was frequently discussed in HOP (45.16%) interviews (Table 3).

Poverty, Homelessness, and Unemployment

Some participants described experiencing homelessness, unemployment, job loss, and poverty. This contributed to experiencing high levels of stress, social isolation, and marginalization; these descriptions did not appear to differ much by personality traits

(Table 3). Combined with an active addiction, and the need to avoid withdrawal states, some participants described circumstances of poverty pressuring them into crime as a way of financially supporting their substance use.

“Imagine if you need that to... and you have no money. You have to go find money first then go. And when you're going to look for money, you're so weak, that you can't do anything anyways, so ... you're basically crawling on the streets looking for money” (E130, male, age 46, IMP).

Trauma

Many participants described various traumatic situations, ranging from childhood abuse, sexual violence, interpersonal violence, operational traumas, accidents, and death or near-death experiences (e.g., witnessing friends overdose or overdosing themselves). These scenarios were often described as an important contributor to developing and maintaining later substance use or anti-social behaviour.

“But I used to use...just to escape...an' bein'- bein' sexually abused... Bein' beaten, by my dad an' stuff. And as I got older I- like I never dealt with it when I was younger. Then when I hit like eighteen, nineteen... I was out breakin' the law... goin' back and forth to jail... it just... one thing led behind- after another just my life spun out of control.” (B143, male, age 42, IMP)

Interestingly, trauma was frequently discussed in the SS interviews (51.43% of endorsed adversity references, Table 3); however, closer inspection reveals that these references were mostly concentrated in one SS interview with a participant that disclosed being diagnosed with post-traumatic stress disorder because of a job-related traumatic exposure. He explained being attracted to a career as a coast guard because of the

excitement the job offered, but that he eventually turned to drinking and substance use as a means of coping with painful memories of traumatic rescue attempts.

Interpersonal Conflict

This theme included codes centered around behaviours that describe various forms of interpersonal relationship ruptures. Participant experiences of feeling marginalized or stigmatized by society are also included here. This theme often overlapped with the “deception” component of the anti-social behaviour external theme. Many participants described the major impact that addiction has had on their social network, including needing to hide their substance use behaviours from others, and the devastating consequences to their interpersonal relationships when they could no longer keep up an act.

*“I-you know what, I honestly don't know how I was able to hide it for so long. Like, without, you know, my wife knowing at all. It ... still amazes me to this day how I could hide it for that long of a time. She got me though, she dug in my pockets one night I was sleeping *participant laughs*. She pulled it, “what the hell is this?” big old bag of, uh, I can't even remember how I responded. I don't think I said too much” (A118, male, age 42, HOP)*

Interpersonal conflict was moderately endorsed by all profiles, except for SS which had low endorsement of this theme (8.7% of references coded; Table 3).

Substance Use

Discussions around substance use featured heavily throughout all interviews, and mainly clustered around (1) substance type and (2) substance use motives (i.e., reasons

for substance use). Participants also spoke about various methods of use (e.g., injection, snorting, oral) and maintaining factors for their use (e.g., craving, withdrawal symptoms, and social network use).

Substance Type

Participants described a wide range of substances, including alcohol, tobacco, cannabis, opioids, stimulants, tranquilisers, hallucinogens, and ecstasy. The relative distribution of coded references across each drug category among each personality group is shown in Table 4. Of note, IMP showed non-specificity with relatively equal endorsement across several drug categories: alcohol (13.85%), tranquilisers (19.49%), cannabis (21.54%), and opioids (24.62%). In contrast, SS interviews frequently referenced alcohol (25.34%) and opioids (34.93%), AS frequently referenced tranquilisers (35.21%), while HOP frequently referenced stimulants (38.55%), opioids (27.71%), and drugs non-specifically (20.48%).

Substance Use Motives

Motives for use included (1) conformity, (2) enhancement, (3) expansion, (4) social, (5) pain relief, (6) coping with anxiety, stress, or trauma, (7) coping with depression, and (8) coping with withdrawal. For brevity, example excerpts for each motive can be found in Table 5. Overall, all personality profiles referenced more frequent negative reinforcement motives (e.g., coping motives) relative to positive reinforcement (i.e., social, enhancement, or expansion motives). However, this relative preference for negative reinforcement was more pronounced for the internalizing personality profiles (AS and HOP) relative to the externalizing profiles (SS and IMP). The relative

endorsement of each motive by personality group is shown in Table 6. Relative to other motives: SS endorsed enhancement motives most frequently (29.69%); IMP endorsed enhancement (24.44%) and coping with anxiety, stress, and trauma (28.89%) motives; and AS endorsed coping with anxiety (41.38%) motives. Of note, when examining the specific coded content of the broad coping with anxiety motive, IMP endorsed a variety of such motives including coping with anxiety, stress, and trauma, while AS endorsed coping with anxiety symptoms almost exclusively. Finally, HOP endorsed both coping with depression (31.25%) and enhancement (31.25%) motives. However, when examining the qualitative nature of the enhancement motives endorsed in HOP interviews, the context surrounding their enhancement motives seemed to relate to seeking energy, waking up, or escaping anhedonic states. As one participant explained: *“I just didn’t care about anything, like, good or bad, just I felt good and that was all I cared about I guess.”* (B208, female, age 29, HOP).

Discussion

This study employed a mixed methods design combining thematic and content analysis to investigate the lived experience of OAT clients scoring highly on SURPS personality traits. Our two goals were to extending theory on the four-factor personality vulnerability model (Castellanos-Ryan & Conrod, 2012) among MMT clients, and to provide client-informed material for future manualized personality-targeted intervention development. These lived experiences were described through three major themes, which included symptoms of internalizing and externalizing forms of psychopathology, adverse experiences, and substance use.

When asked to tell a story about how their personality got them into trouble, participants described a variety of thoughts, affects, and behaviours that fell under a general theme describing various internalizing (i.e., a tendency to express distress internally, such as depression, anxiety and fear) and externalizing (i.e., a tendency to express distress externally, including substance use problems and behavioral problems) psychopathology symptoms, which correspond to existing and well known quantitatively derived transdiagnostic models of psychiatric comorbidities (i.e., internalizing-externalizing model; see Carragher et al., 2015; Eaton et al., 2015). In this study, MMT clients reported internalizing symptoms comprised of depression, anxiety, panic, and avoidance. They also reported externalizing symptoms of disinhibition (difficulty controlling impulses and not thinking about the consequences of actions), anger, thrill seeking, aggression, and other anti-social behaviours (e.g., criminality). These symptoms were heavily intertwined with substance use and other adverse experiences, including trauma exposure, poverty, health problems, interpersonal problems, and marginalization/stigmatization. This intertwining highlights the complex interplay between these factors and the need for additional psychosocial services that can address these complex comorbidities (MacNeill et al., 2019, 2020; E. C. Saunders et al., 2021).

Personality Targeted Model

This study provides additional validation of the four-factor personality vulnerability model (Castellanos-Ryan & Conrod, 2012; Conrod, Pihl, et al., 2000; Pihl & Peterson, 1995) in MMT clients by demonstrating personality-specific patterns of internalizing and externalizing symptoms of psychopathology, preference towards specific substances, and preference towards specific motives for use. Our findings

suggest that personality-targeted treatment manuals can be designed to target specific cognitive, affective, and behavioral patterns within each personality type.

Sensation-Seeking

MMT clients scoring high in SS described a thrill seeking, reward sensitive cognitive style that drives them to take risks and break rules (including engaging in crime). They also endorsed a moderate level of depressive symptoms and traumatic events. The preference towards increasing their arousal levels may predispose individuals high in SS to engage in risky activities with negative consequences (e.g., binge drinking and getting injured, chasing a high and risking an overdose), highlighting that treatment manuals with high SS MMT clients should focus on encouraging more safe and effective ways to meet their needs for arousal and excitement (Roberti, 2004). Consistent with theory (Castellanos-Ryan & Conrod, 2012), motives for substance use among SS largely focused on enhancement (i.e., to get high, for pleasure), but also included a variety of coping motives, similar to prior research highlighting that clinical populations of substance users engage in coping motivated use (Mezquita et al., 2011).

Impulsivity

MMT clients scoring high in IMP described a combination of both externalizing and internalizing symptoms of psychopathology. This group was characterized by themes reflecting a general tendency to act automatically without thinking through the consequences, or a feeling of not having control over one's actions. This personality profile also reported more instances of anger, frustration, and aggression, relative to the other profiles, and showed a moderate endorsement of depression, anxiety, and stress.

These themes were intertwined with a wide range of adverse experiences, including interpersonal conflict, marginalization, health problems, and trauma. High IMP clients also referenced heterogeneous motives for use which included both positive reinforcement (e.g., enhancement) and negative reinforcement (e.g., coping with anxiety, stress, or trauma and coping with depression) motives. Treatment for high IMP MMT clients may need to address not only cognitive disinhibition and its' consequences, but also provide effective emotional regulation strategies, particularly for addressing depression, anxiety, and stress.

Hopelessness

By and large, MMT clients scoring high in HOP described an internalizing profile of psychopathology symptoms consisting of high levels of distress, sadness, and depression. Their descriptions frequently included stories of loss, relationship ruptures, low social support, and chronic health problems, including experiencing chronic pain. HOP is a known risk factor for depression (Conrod et al., 2000) and health problems (Everson et al., 1996; Kubzansky et al., 2005). Additionally, depression and depression-like traits (i.e., hopelessness) and chronic pain have bi-directional associations (Gustin et al., 2013; Sheng et al., 2017). These multiple risk factors likely play an important role in the emergence and/or maintenance of the internalizing symptoms reported by our sample, and will need to be carefully considered by clinicians. Discussions around substance use often focused on opioids as a form of coping with these internalizing symptoms, but also included stimulant use (i.e., crack cocaine) to provide energy and to escape feelings of anhedonia. Treatment for high HOP MMT clients will need to consider not only effective alternative strategies for coping with low mood and interpersonal conflict, but also include

alternative strategies for coping with pain or health problems (e.g., see Sturgeon, 2014) and for achieving energy and pleasure.

Anxiety Sensitivity

Clients scoring high on AS reported an internalizing profile largely characterized by anxiety, fear, and avoidance coping strategies. Consistent with prior research linking AS with panic disorder (McNally, 2002), experiences of panic symptoms (e.g., catastrophizing about physical sensations) and fear were frequently discussed by this group. Although all profiles described the unpleasantness of opioid withdrawal symptoms, these descriptions occupied more of the overall discussion among AS individuals. Health problems were also frequently discussed among AS clients, which may be due to their enhanced somatic sensitivity and high levels of health anxiety (Wright et al., 2016). Use of tranquiliser drugs such as benzodiazepines were frequently discussed. These were often prescribed, and largely used for coping with anxiety. Similar to recommendations from other investigators (Hearon et al., 2011; McHugh et al., 2017), psychosocial treatment for high AS MMT clients will need to consider addressing symptoms of anxiety, panic, and other negative affective states.

Limitations

Our findings have several important limitations. Although our total sample size was sufficient to reach saturation for identifying a variety of deductive and inductive themes (B. Saunders et al., 2018), it was relatively small at the sub-group level, and some personality profiles (e.g., IMP) were more talkative than others (e.g., AS), thus providing more data. Although we focused on within-personality coding to attenuate the influences

of this discrepancy, it is possible that additional themes may have emerged from recruiting more participants, particularly AS participants. Another major limitation of this work is that the interviewers were not blind to the personality of the interviewee. Although this was necessary here as the goal was to collect specific information for the development of manual content, future qualitative studies may consider employing interviewers blind to personality status and asking non-specific questions about the links between personality and behaviour. Additionally, most of the participants were middle-aged and White. While this is representative of the demographics of those at the clinics where recruitment took place, it is possible that additional or different themes might emerge among younger or more diverse MMT clients. Finally, participation in the study was voluntary; these themes may not generalize to MMT clients who would not want to engage in semi-structured interviews.

Conclusions

This study provides additional qualitative support that personality remains an important correlate of various cognitive, affective, and behavioral processes among OAT clients including substance use (Mahu, Conrod, Barrett, Sako, et al., 2019 - Chapter 2) and substance use motives (Mahu et al., 2021 – Chapter 6). Themes identified through this study can be adapted into “scenarios” for future adaptations of existing personality-targeted treatments (Conrod, 2016) to reduce distress and polysubstance use among OAT clients. Future studies should consider examining the various symptom clusters and adverse experiences identified in these interviews and their relationships with personality using quantitative methodologies among clients struggling with opioid addiction.

Acknowledgements

This study would not have been possible without the help of our collaborators at each of the four methadone clinics. We would also like to extend special thanks to the volunteers and research assistants that have helped with transcribing the data and helped with recruitment.

Tables

Study 3 Table 1. Participant Demographics

Demographics				
Variable	Counts	% of Total	Cumulative %	
Gender				
Men	13	65.0 %	65.0 %	
Women	7	35.0 %	100.0 %	
Employment				
Unemployed	5	26.3 %	26.3 %	
Social Assistance	1	5.3 %	31.6 %	
Employed	9	47.4 %	79.0 %	
Disabled	4	21.0 %	100.0 %	
Ethnicity				
Indigenous/Aboriginal/First Nations	2	10.0 %	10.0 %	
Black, Afro-Canadian, Caribbean-Canadian	1	5.0 %	15.0 %	
White	16	80.0 %	95.0 %	
Other	1	5.0 %	100.0 %	
Highest Education Completed				
Elementary school	2	10.0 %	10.0 %	
Junior High school	3	15.0 %	25.0 %	
High school	8	40.0 %	65.0 %	
Trade school	4	20.0 %	85.0 %	
Community School	1	5.0 %	90.0 %	
Some university/ college	1	5.0 %	95.0 %	
University/ college degree	1	5.0 %	100.0 %	
Relationship Status				
Single (never married)	10	50.0 %	50.0 %	
Married/ Cohabiting	3	15.0 %	65.0 %	
Seperated/ Divorced	6	30.0 %	95.0 %	
Common Law	1	5.0 %	100.0 %	
Current Living Arrangements				
Renting	13	65.0 %	65.0 %	
Own your own home	2	10.0 %	75.0 %	
Living with family (not paying rent)	2	10.0 %	85.0 %	
Community shelter/ transitional housing	1	5.0 %	90.0 %	
Living with a roommate	2	10.0 %	100.0 %	
Yearly Income				
\$0 to \$10,000	6	30.0 %	30.0 %	
\$10,001 - \$20,000	8	40.0 %	70.0 %	
\$20,001 - \$29,000	3	15.0 %	85.0 %	
\$59,001 - \$60,000	1	5.0 %	90.0 %	

Demographics

Variable	Counts	% of Total	Cumulative %
\$79,001+	1	5.0 %	95.0 %
Other	1	5.0 %	100.0 %
Other Demographics	Counts	Mean	SD
Age (years)	18	42.06	10.20
Daily Methadone Dose (mg)	20	91.30	45.11

Study 3 Table 2. Internalizing and Externalizing Symptoms by Personality Group

Category	Themes	SS (5)	IMP (6)	AS (4)	HOP (5)	Total (20)
Externalizing Symptoms	Anger or Frustration	1.79%	9.12%	1.2%	5.41%	5.95%
	Disinhibited Cognitions	3.57%	21.28%	4.82%	1.35%	11.42%
	Thrill Seeking and Risk Taking	41.96%	9.12%	2.41%	4.05%	12.83%
Internalizing Symptoms	Anti-social Behaviours	18.75%	19.59%	2.41%	14.86%	16.12%
	Anxiety, Fear, or Panic	8.04%	16.22%	55.42%	12.16%	18.94%
	Depression or Low Mood	23.21%	19.93%	13.25%	54.05%	27.54%
	Avoidant Coping Behaviour	2.68%	4.73%	20.48%	8.11%	7.2%
Total % (# references coded)		100% (n=112)	100% (n=296)	100% (n=83)	100% (n=148)	100% (n=639)

Note. SS = Sensation-Seeking. IMP = Impulsivity. AS = Anxiety-Sensitivity. HOP = Hopelessness. Number in parentheses indicates the number of interviews conducted with each profile. Cells are color heat mapped to visually indicate the relative endorsement of each theme within each respective personality group. Red indicates high endorsement, yellow/orange is moderate endorsement, and green is low endorsement.

Study 3 Table 3. Adversity Experiences by Personality Group

Themes	SS (5)	IMP (6)	AS (4)	HOP (5)	Total (20)
Health	24.64%	28.28%	40.0%	42.42%	31.89%
Poverty, Homelessness and Unemployment	14.49%	14.14%	30.0%	16.67%	16.14%
Trauma	52.17%	28.28%	0.0%	16.67%	29.53%
Relationship Damage	8.7%	29.29%	30.0%	24.24%	22.44%
Total % (# references coded)	100% (n=69)	100% (n=99)	100% (n=20)	100% (n=66)	100% (n=254)

Note. SS = Sensation-Seeking. IMP = Impulsivity. AS = Anxiety-Sensitivity. HOP = Hopelessness. Number in parentheses indicates the number of interviews conducted with each profile. Cells are color heat mapped to visually indicate the relative endorsement of each theme within each respective personality group. Red indicates high endorsement, yellow/orange is moderate endorsement, and green is low endorsement.

Study 3 Table 4. Drug Type by Personality

Drug Type	SS (5)	IMP (6)	AS (4)	HOP (5)	Total (20)
Alcohol	25.34%	13.85%	4.23%	6.02%	14.55%
Benzos	2.74%	19.49%	35.21%	0%	13.54%
Cannabis	12.33%	21.54%	1.41%	3.61%	12.93%
Cigarettes	1.37%	1.03%	8.45%	2.41%	2.42%
Hallucinogens	5.48%	0.51%	2.82%	1.2%	2.42%
Opiates	34.93%	24.62%	21.13%	27.71%	27.68%
MDMA	0%	0%	5.63%	0%	0.81%
Stimulants	10.27%	6.15%	12.68%	38.55%	13.74%
Drugs (unspecified)	7.53%	12.82%	8.45%	20.48%	11.92%
Total % (# references coded)	100% (n=146)	100% (n=195)	100% (n=71)	100% (n=83)	100% (n=495)

Note. SS = Sensation-Seeking. IMP = Impulsivity. AS = Anxiety-Sensitivity. HOP = Hopelessness. Number in parentheses indicates the number of interviews conducted with each profile. Cells are color heat mapped to visually indicate the relative endorsement of each theme within each respective personality group. Red indicates high endorsement, yellow/orange is moderate endorsement, and green is low endorsement.

Study 3 Table 5. Motives for Substance Use Excerpts

Motives	Excerpts
Enhancement	<p><i>“Uhh, the energy, like, \$10 worth would last you 3-4 days and you would stay awake for 16-18 hours at a time and, and still perform regularly, like you know, you felt like superman, like literally, like there's nothing you couldn't do and you were always wide awake, alert, you weren't like slurring, or passing out or anything like that so nobody could look at you and think that you are high on crystal meth.”</i> (A118, male, age 42, HOP)</p> <p><i>“And I know if I take a handful of ‘em I’m gonna get high off them. [...] I found out real quick if I took two or three of those I was fucked up. [...] I knew, I, I realized right away the more pills I took the better I felt. And it was just game on from the minute they put me on them.”</i> (A105, male, age 48, IMP)</p>
Social	<p><i>“But others, and we'd uh have a couple of tokes of that, play some music, and sort of a social thing, that's...”</i> (A103, male, age 61, SS)</p> <p><i>“For example, this morning, I got up, I called a friend. He came by we had breakfast -- a coffee, peanut butter sandwich – and we smoked a joint. Because my friend was there. If he wasn't there, I would have smoked around two o'clock three o'clock.”</i> (C115, male, age 51, IMP)</p>
Expansion	<p><i>“Exactly, you, you can hang back watch a show or hang with your friends or, or do something on the computer just and it puts an extra spin on the end of it”</i> (C115, male, age 51, IMP)</p>
Conformity	<p><i>“But it was also because I wanted to fit in with them there. That's what they were doing, they smoked. I didn't want to be left out, so I started smoking with them, and I made myself some friends.”</i> (C210, female, age 50, SS) [Author translation, original in French]</p> <p><i>“Mmm...TV shows or y'know someone else that's using beside me. Y'know, like before I had gotten married uh... y'know I was using opiates and people were smoking crack beside me and shootin' it up and, or shootin' up their pills and y'know...before I would just say fuck it and I'd- and I'd do up a head or I'd smoke this or smoke that.”</i> (A154, male, age 43, IMP)</p>
Coping with Anxiety, Stress, or Trauma	<p><i>“I used to rely on Benzodiazepines and alcohol. When I was younger. To... To keep myself calmed down and relax and all that that but...the main reason I smoke marijuana now too ... at-you know- three four grams a day ... the only reason I'm using so much right now is 'cause I'm all stressed out.”</i> (A105, male, 48, IMP)</p>

“Without it sittin' there torturin' your brain and your mind too. 'Cause that's why people will use, ... most people that use drugs and alcohol... betcha ninety percent's been abused. In some form or way. Sexually, physically, mentally, what have you.” (B143, male, age 42, IMP)

Coping with Depression

“Thinking about, thinking about different things that have happened in my life, different situations with my family... or if I feel lonely, when I feel lonely or I feel like I don't have anybody that I can turn to, that's usually when I feel like I need to use the worst” (B136, male, age 28, SS)

“Numbed out, I guess. Not physically numb, but your body is not numb, but your brain gets fully numb and you just, you don't wanna think. Basically you just wanna sit back and just, enjoy, right? Take it in, I guess. Escape reality, I guess you could call it. It's an escape.” (C112, male, age 32, HOP)

Coping with Withdrawal

“To get that fix for the day an' then, you go to sleep, the next day you gotta worry with the stress again. The same thing 'cause you don't wanna be all sick and sore.” (B143, male, age 42, IMP)

“I don't know, a couple times I couldn't get my methadone. And I didn't wanna be sick all day so I managed to get a pill. And one was just recently. Uhh, last month or somethin'. I couldn't get my methadone.” (A207, female, AS)

Coping with Pain

“It didn't work for very long and then somebody introduced that crystal meth and it seemed to take all my pains away, all aches/pains I could- I was a new man after that and then I hid it for years and years and years.” (A118, male, age 42, HOP)

“ I uh, you know I'll eat uh some morphine pills or whatever... Something to just kinda relax me 'cause I don't think, like they say methadone is like helps the pain instead of- it helps the pain from the ... prior opiate use, it doesn't help body pain.” (A154, male, age 43, IMP)

Note. SS = Sensation-Seeking. IMP = Impulsivity. AS = Anxiety-Sensitivity. HOP = Hopelessness.

Study 3 Table 6. Motives for Substance Use Endorsement by Personality Type

Motives for Use	SS (5)	IMP (6)	AS (4)	HOP (5)	Total (20)
Conformity	1.56%	3.33%	3.45%	3.13%	2.79%
Enhancement	29.69%	24.44%	20.69%	31.25%	26.51%
Expansion	1.56%	2.22%	0%	0%	1.4%
Social	9.38%	2.22%	0%	3.13%	4.19%
Coping with Pain	6.25%	10%	0%	12.5%	7.91%
Coping with Anxiety, Stress, or Trauma	17.19%	28.89%	41.38%	15.63%	25.12%
Coping with Depression	17.19%	18.89%	20.69%	31.25%	20.47%
Coping with Withdrawal	17.19%	10%	13.79%	3.13%	11.63%
Total % (# references coded)	100% (n=64)	100% (n=90)	100% (n=29)	100% (n=32)	100% (n=215)

Note. SS = Sensation-Seeking. IMP = Impulsivity. AS = Anxiety-Sensitivity. HOP = Hopelessness. Number in parentheses indicates the number of interviews conducted with each profile. Cells are color heat mapped to visually indicate the relative endorsement of each theme within each respective personality group. Red indicates high endorsement, yellow/orange is moderate endorsement, and green is low endorsement.

CHAPTER 9. GENERAL DISCUSSION

My dissertation sought to validate and extend the Four-Factor Personality Vulnerability model to opioid dependent clients in the MMT setting. Through this task, I hoped to provide rationale for adapting existing personality-targeted interventions to a setting that is in dire need of brief and effective evidence-based approaches to substance use treatment. This involved testing the relationship of the four SURPS personality traits to substance misuse and substance use motives, using both quantitative and qualitative methodologies. The use of Bayesian statistics was employed throughout all quantitative components. The following sections summarize and integrate my findings as they pertain to the existing literature and this overarching goal. I discuss my dissertation's theoretical and clinical implications. I further examine the strengths and limitations of my approach. Finally, I conclude by suggesting related directions for future research.

Summary and Integration of Findings

Summary: Study 1

Study 1 (Chapter 2), entitled “Specificity of personality relationships to particular forms of concurrent substance use among methadone maintenance therapy clients” broadly sought to validate the use of the SURPS in the MMT population. I sought to validate the factorial structure of the SURPS using Bayesian confirmatory factor analysis, and I tested relationships between personality and substance use using a latent hierarchical model. At the time that the study was conceptualized, and data was collected (2015-2016), only one other study (Schlauch et al., 2015) had investigated the relationship between the SURPS and substance use in a clinical population of treatment seeking substance users. This study was therefore quite novel as the psychometric properties of

the SURPS in adults at a later stage of addiction were understudied. Thus, there was great theoretical and clinical interest in investigating whether personality, as measured by the four factor model (Castellanos-Ryan & Conrod, 2012; Conrod, Pihl, et al., 2000; Pihl & Peterson, 1995), could also be implicated in the maintenance of addictive behaviours. This was a cross-sectional multi-site study that recruited opioid dependent clients across four different MMT clinics in two different Canadian cities (Montreal and the Halifax Regional Municipality). To account for potential differences between sites (e.g., differences in treatment philosophy, culture, and language), I controlled for site in all analyses, as well as controlling for methadone dosage and gender. Inclusion criteria required participants to have been a daily witnessed MMT client for at least 30 days, as we wanted to investigate these relationships among individuals who had completed a stabilization period on methadone.

First, we hypothesized that the four-factor structure of the SURPS observed in other populations (Long et al., 2018; Schlauch et al., 2015; Woicik et al., 2009) would be replicated within the MMT population and provide a better fit than an alternative two factor typology (i.e., internalizing vs. externalizing). Second, we sought to establish construct validity of the SURPS by investigating whether theoretically relevant relationships between personality and substance use could be replicated among MMT clients. We hypothesized that HOP would be associated with recent use of opioids; AS with recent use of anxiolytics; SS with recent use of stimulants, alcohol, and cannabis; and IMP with recent use of stimulants and injection drug use.

One of the criticisms of the SURPS (see Blanchard et al., 2020) is that the psychometric properties of the scale shown in previous validation studies achieved good

fit only by correlating residual errors (Jurk et al., 2015; Woicik et al., 2009) and cross-loading items (Krank et al., 2011). A number of SURPS validation studies have also removed items with low loadings or cross-loadings, e.g.: items 16, 19, and 22 (Krank et al., 2011), item 16 (Castellanos-Ryan et al., 2013; Newton et al., 2016), items 6 and 22 (Kaminskaite et al., 2020), items 16 and 17 (Schlauch et al., 2015), items 1, 3, 8, 12, 14, 17, 19, 22 (Blanchard et al., 2020); making direct comparisons between studies more difficult and casting doubt on the clinical “real-world” utility of the scale. Given criticisms that latent structures derived from factor analytical studies do not represent the real use of the SURPS in clinical and research settings (Blanchard et al., 2020), we tested these relationships in two separate models: (1) a model using SURPS summed scores, representing a real-life use of the instrument as originally described by Woicik et al. (2009), and (2) a model using latent structures estimated from the original items corresponding to each subscale. We hypothesized that if the SURPS is an accurate clinical instrument among MMT clients, we would expect to replicate the personality-substance use relationships across both “summed” and “latent” models.

Data analysis followed a Bayesian approach and provided reasonable model fit indices. Consistent with our hypotheses and with the underlying theory (Woicik et al., 2009), we found greater support for a four-factor model relative to the two-factor model. Consistent with our hypotheses, HOP was associated with higher rates of recent opioid use; AS was associated with higher rates of recent tranquilizer use; SS was associated with higher rates of recent stimulant, alcohol, and cannabis use. Contrary to our hypotheses, IMP was not associated with higher rates of stimulant use, but we did find partial support of our hypothesis that IMP would be associated with injection drug use (in

the summed scores model only). HOP was also associated with tranquiliser use, but only when examining the summed scores model. Overall, the SURPS appears to perform very well when used “out-of-the-box” (i.e., just summing item scores), although slightly greater predictive precision can be obtained by using a latent variable approach. This is likely due to cross-loading of certain items, which emerges when using the summed scores model out of the box. Post-hoc investigations of item cross loading in my data suggests that item 17 (“I feel that I’m a failure”), which had a relatively low factor loading in this study when compared with other HOP items, cross loaded on both AS and IMP factors. This is identical to results reported by Schlauch et al. (2015). Woicik et al. (2009) also reported that item 17 cross-loaded with HOP and AS. Blanchard et al. (2020) noted that this item provided poor discrimination of the latent trait, but that removal of this item resulted in reduced predictive utility. It is likely that this item measures neuroticism more broadly, which may explain the minor difference in results between the summed and latent models.

I concluded that the SURPS displayed structural and construct validity, and adequate-to-good internal consistency among MMT clients, which suggests that it is a useful tool even in a population at a later stage of addiction. I highlighted several potential treatment areas that would likely be relevant for each personality trait based on the pattern of results observed (e.g., HOP and a therapeutic focus on depressogenic thinking/depressive symptoms; AS and a focus on anxiety regulation; SS and a focus on need for stimulation). Although it was cross-sectional, this study provides the justification to pursue this research question in a much more expensive and resource intensive prospective design in future.

Summary: Study 2A

Study 2A, entitled “Different drugs come with different motives: Examining motives for substance use among people who engage in polysubstance use undergoing methadone maintenance therapy (MMT)” examined 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). This study was particularly novel as (1) we developed a new brief motives measure designed to rapidly measure motive endorsement in research or clinical contexts where polysubstance use was common, and (2) we utilised a statistical design suitable to analyzing unbalanced data (i.e., some substances used more commonly than others so differing amounts of motives data was available across substances). Although a variety of motives questionnaires have been developed for various specific substances, they varied in their item content making direct comparisons across substances difficult. Moreover, because each measure typically includes 20+ items, measuring substance use motives in clinical settings with polysubstance users became impractical due to high participant burden. It has thus been difficult to study whether motivational dynamics are common (i.e., “trait-like”) or specific to a given substance (i.e., “state-like”). This study was cross-sectional and used data collected at the same time as data for Study 1.

Because different drugs have varying pharmacological and phenomenological experiences, we expected motive endorsement to differ significantly between drug categories. We hypothesized that (1) enhancement motives would be high for all drug categories except tranquilisers; (2) social motives would be high for alcohol and

cannabis, relative to other substances; (3) expansion motives would be high for cannabis, relative to alcohol and tobacco; (4) coping with anxiety motives would be high for tranquilisers relative to other drugs and low for stimulants; (5) coping with depression motives would be high for alcohol and opioids; (6) conformity motives would show no differences between drugs due to this motive being uncommon among adults; (7) coping with withdrawal motives would be more commonly endorsed in substances with severe withdrawal syndromes such as alcohol, tobacco, opioids, and tranquilisers, relative to cannabis and stimulants. To account for unbalanced data (i.e., not all participants used all drugs), I used Zero-inflated Beta Bayesian Linear Mixed Modeling (LMM). The Beta link was used to accurately model data emerging from a visual analogue scale. To estimate the extent to which different motives had trait vs state properties, I created a new metric I entitled a “deviance score”. This metric was derived by extracting all possible pairwise contrasts from the posterior distribution and calculating the proportion of non-equivalent values exceeding a standardized difference of plus or minus 0.1. A motive category with a higher deviance score was taken as evidence that there is more variance in motive endorsement across drugs and therefore that motive would be considered to have “state-like” properties.

This study was the first to compare motive endorsement across six different drug categories in the same sample. It also demonstrated that motives for use largely mapped onto the known pharmacological effects of substances, such that most motives varied significantly across substances. All the internal motives (i.e., expansion, enhancement, and all three coping motives) showed higher deviance scores, suggesting that internal motives have state-like properties (although it is important to highlight that they also had

some trait-like properties). Ranging from most trait-like to most state-like, the respective ranking of internal motives was as follows: coping with depression, coping with anxiety, enhancement, expansion, and coping with withdrawal. In contrast, external motives (i.e., conformity, social) showed the most stability across substances and were the most convincingly trait-like. Conformity motives, in particular, were almost entirely trait-like, although this may be an artifact of the low endorsement of this motive in this sample.

Results from this study also showed that enhancement, coping with anxiety, and coping with depression motives were consistently highly endorsed by the MMT clients across most substances. Consistent with our hypothesis, enhancement motives were endorsed more frequently for cannabis, stimulants, and opioids than tobacco and tranquilisers. When ranked by relative importance, enhancement motives ranked first for stimulants, second for alcohol, cannabis, and opioids, and third for tranquilisers. Contrary to our hypothesis, social motives did not show strong evidence of specificity in favor of alcohol and cannabis, although they were endorsed more frequently for cannabis relative to tranquilisers and tobacco. Consistent with our hypothesis, expansion motives were endorsed more frequently for cannabis relative to tobacco and alcohol; but unexpectedly expansion motives were also relatively highly endorsed for stimulants (relative to alcohol, tobacco, and tranquilisers) and opioids (relative to tobacco and tranquilisers). Consistent with our hypothesis, stimulants were less likely to be used for coping with anxiety than tranquiliser drugs. Partially consistent with our hypothesis, participants reported using tranquilisers to cope with anxiety more frequently than alcohol, cannabis, stimulants, and opioids. Relative to other motives, coping with anxiety was highly ranked for almost all substances, ranking first in importance for tobacco, alcohol, cannabis, and

tranquilisers. Coping with depression motives results largely mirrored those for coping with anxiety, although some specificity emerged showing that tobacco and tranquilisers were endorsed more frequently for coping with anxiety relative to depression. Partially supporting our hypothesis, coping with depression motives were more strongly endorsed for opioids and cannabis relative to tobacco and stimulants. Coping with depression motives ranked second in relative importance for tobacco, stimulants, and tranquilisers; and third for alcohol, cannabis, and opioids. Indeed, both coping with negative emotion motives were strongly endorsed across all drug categories. Consistent with our hypothesis, conformity motives showed no specificity, and were the least endorsed motive across all drug categories. Consistent with our hypothesis, coping with withdrawal motives were most strongly endorsed for opioids. However, withdrawal motives were also more strongly endorsed for cannabis, tobacco, and tranquilisers relative to alcohol and stimulants. These results were maintained even when controlling for interactions with methadone dosage and compliance. Withdrawal motives ranked first in importance for opioids, and third for tobacco.

I concluded that coping with anxiety, coping with depression, and enhancement motives are intimately implicated in substance use among MMT clients. Coping with withdrawal motives were also particularly important for opioids, but also highly endorsed in tobacco, cannabis, and tranquiliser use, highlighting the importance of withdrawal management in MMT. Because motives vary significantly across drug categories, proper management of polysubstance use in MMT clients will need to consider a substance-specific targeted approach.

Summary: Study 2B

Study 2B, entitled “Motivations for Substance Use among Methadone Maintenance Therapy (MMT) Clients: Interactions between Personality and Substance Type”, extended the analyses from Study 2A to include personality interactions with drug class in the concurrent prediction of substance use motives. My research question examined whether SURPS personality traits moderate the endorsement of any substance use motives across six different drug categories (tobacco, alcohol, cannabis, opioids, stimulants, and tranquilisers). The models reported in study 2A were updated to include interaction terms between personality and drug class. These slope parameters were reported in terms of positive directional probabilities, calculated as the proportion of the posterior distribution showing a positive non-zero estimate. I tested two main research questions: (1) when averaging across all drug categories, is there a main effect of personality on motives and (2) are there specific interaction effects between certain personality traits and particular drug classes.

The main effect hypotheses largely pertained to theoretical predictions made by the four-factor personality vulnerability model (Castellanos-Ryan & Conrod, 2012; Conrod, Pihl, et al., 2000). I hypothesized that (1) SS would be positively related to enhancement, social, and expansion motives; (2) IMP would show a diffuse and non-specific pattern of use; (3) HOP would be positively related to coping with depression motives; and (4) AS would be positively related to coping with anxiety and coping with withdrawal motives.

These main effect hypotheses were largely unsupported by the data, which is not surprising given the heterogeneity seen in substance use motives across drug categories in Study 2 (Chapter 4). When controlling for drug category, (1) there was a trend towards

SS being associated with social motives, but evidence for the robustness of this effect was lacking. Unlike previous substance-specific studies reporting non-specific motivational patterns for IMP (Schlauch et al., 2015; Woicik et al., 2009), (2) we found specificity for greater endorsement of coping with depression and coping with withdrawal motives. Rather than noticing a positive relationship between HOP and coping with depression motives predicted by the four factor model (Castellanos-Ryan & Conrod, 2012; Conrod, Pihl, et al., 2000), (3) HOP showed a generalized pattern of negative endorsement of almost all motives, except for coping with depression motives, which showed no evidence of directionality in either positive or negative directions. Finally, although our (4) hypothesis regarding a positive association between AS and coping with anxiety and coping with withdrawal was confirmed, AS was also positively related to almost every other motive, showing a generalized non-specific pattern of motive endorsement.

Because findings from Study 2A suggested that motives are endorsed differently across substances (see Chapter 4), I expected the effects of personality to become most apparent when examining interactions with specific substances. Therefore, ten specific interaction hypotheses were made with respect to certain substances, based on the limited available literature examining SURPS and motives for use (Chinneck et al., 2018; Hecimovic et al., 2014; Schlauch et al., 2015; Woicik et al., 2009). I hypothesized that SS would show interaction effects with (1) alcohol (for predicting greater endorsement of enhancement and social motives), (2) cannabis (for predicting greater endorsement of expansion motives), and (3) stimulants (for predicting greater endorsement of enhancement motives). I further expected that IMP would be (4) positively related to

coping with withdrawal motives for opioids specifically. I hypothesized that HOP would be positively related to coping with depression motives for (5) alcohol, (6) cannabis, and (7) opioids. Finally, I expected that individuals scoring high in AS would be more likely to endorse coping with anxiety and coping with withdrawal motives for (8) tranquilisers and (9) tobacco specifically, and (10) more likely to endorse conformity motives for cannabis. Other possible relationships were exploratory.

The interaction hypotheses for SS (H1-3) predicting greater endorsement of enhancement, social, and expansion motives for alcohol, cannabis, and stimulants specifically were not supported. Instead, we found evidence that SS was positively related with enhancement motives for tranquilisers, social motives for tobacco, conformity motives for tranquilisers, and coping with withdrawal motives for alcohol.

The interaction hypothesis for IMP (H4) suggesting a positive association with coping with withdrawal motives for opioids was supported. Furthermore, IMP was also positively associated with enhancement motives for stimulants, coping with depression motives for alcohol and opioids, and negatively associated with coping with depression motives for cannabis.

The interaction hypotheses suggesting a positive link between HOP and coping with depression were partially supported for alcohol only (H5), although the evidence was weak. This assumed relationship did not replicate for either (H6) cannabis or (H7) opioids. Instead, HOP was only positively associated with coping with anxiety motives for alcohol specifically. HOP was negatively associated with endorsing social motives for cannabis and opioids; expansion motives for cannabis; coping with anxiety motives for tobacco, cannabis, and opioids; conformity motives for opioids; and coping with

withdrawal motives for cannabis. In short, these results largely mirror the main effect findings in respect to HOP but suggest that alcohol is used to cope with anxiety among high HOP individuals.

The hypothesized relationship between AS and coping with anxiety was largely in the expected direction relative to (H8) tranquilisers and (H9) tobacco, however it remained relatively uncertain. The same is true for the hypothesized relationships with coping with withdrawal. As hypothesized, AS was positively associated with conformity motives for cannabis (H10), but unexpectedly this also replicated for tranquilisers. AS was also associated with positive endorsement of several motives across various drug classes, including enhancement motives for tobacco; social motives for opioids; expansion motives for tobacco, cannabis, and opioids; and coping with depression motives for tobacco, cannabis, and tranquilisers.

In a study examining main effects and interactions between four personality traits and six classes of drugs across seven outcomes, the reader may find themselves lost in the multitude of results. I will briefly highlight what I believe to be the main theoretical contributions here regarding the relationship between personality and motives. First, SS was linked to enhancement and conformity motives for tranquilisers specifically, suggesting possible intervention strategies for reducing benzodiazepine use among high SS individuals. Additionally, coping with withdrawal motives should be further investigated in relation to alcohol use among high SS individuals. Second, while non-clinical samples of high IMP individuals report a diffuse pattern of motives (at least with respect to drinking motives in the literature; Woicik et al., 2009), this was not the case among MMT clients. Instead, IMP here was positively associated with coping with

depression and coping with withdrawal motives overall, and when looking at alcohol and opioids specifically. This underscores the importance of relapse prevention and treatment of mood disorders among high IMP individuals. Higher IMP was also linked with enhancement motives for stimulants specifically. Third, individuals high in HOP reported coping motives for alcohol, but may be using other substances for reasons that were not measured (i.e., coping with pain). Fourth, individuals high in AS showed a diffuse pattern of substance use motives, yet showed stronger endorsement of coping and conformity motives for tranquilisers relative to other motives.

Summary: Study 3

Study 3 (Chapter 8), entitled “*The Four-Factor Personality Model and its Qualitative Correlates among Methadone Maintenance Therapy (MMT) Clients*”, aimed at investigating the lived experience of MMT clients scoring high on each SURPS personality trait. We sought to understand how each of the four SURPS traits is related to high-risk behaviours among MMT clients, including substance use and motives for substance use. To aid with future treatment manual development, we were also interested in understanding how each trait presents itself through the lens of a cognitive-behavioral model (i.e., situations, cognition, affect, and behaviours). I combined two different qualitative methodologies to explore these questions: first I obtained themes through thematic analysis, and then I described these themes quantitatively by using content analysis to help visualize the data. Twenty MMT clients scoring high on at least one SURPS trait who took part in the quantitative surveys described through Studies 1 and 2A/B (Chapters 2, 4, and 6) were invited to take part in a semi-structured interview where they talked about how understood their personality and gave examples of various difficult

situations they had encountered. Although not part of this dissertation, they also provided feedback on existing personality-targeted manuals (Mahu, Conrod, Barrett, MacIsaac, et al., 2019).

The main themes that emerged from these personality-targeted interviews included (1) internalizing and externalizing symptoms, (2) adversity experiences, and (3) substance use. The first theme, internalizing and externalizing symptoms, reflects various affective, cognitive, and behavioral subthemes which fall under symptom descriptors for psychopathology. Under the internalizing umbrella, this included experiences of (1) anxiety, fear, stress, (2) sadness or depression, and (3) avoidant coping behaviours. Under the externalizing umbrella, this included (4) anger/frustration, (5) disinhibited cognitions, (6) anti-social behaviours, and (7) thrill seeking/risk taking behaviours and cognitions. Adversity experiences included a wide range of environmental antecedents or consequences relative to the internalizing and externalizing psychopathology symptoms described previously. The major sub-themes under this umbrella included (1) poor health, (2) poverty/homelessness/unemployment, (3) traumatic experiences, and (4) interpersonal conflict. Finally, the last major theme was substance use, which included descriptions of (1) substance type and (2) substance use motives. In the latter subtheme, all seven previously discussed motives appeared, as well as coping with pain motives. Coping with stress and coping with trauma motives were also endorsed, but these were combined with coping with anxiety due to low endorsement and because it was difficult to separate them from coping with anxiety.

When looking at the endorsement of certain themes across personality traits, this study largely supported the theory behind the four-factor personality model of

vulnerability (Castellanos-Ryan & Conrod, 2012; Conrod, Pihl, et al., 2000; Pihl & Peterson, 1995) and extends this theoretical model to MMT clients. For example, I found that MMT clients high in SS described a thrill seeking, reward sensitive cognitive style that motivated them to engage in risk-taking and anti-social behaviours. Interviews often featured discussions about alcohol and opioids, and motives for use endorsed by high SS people largely focused on enhancement, but also included coping motives.

Clients scoring high in IMP endorsed both internalizing and externalizing symptoms, and their stories often featured a cognitive style reflective of a tendency to act automatically without considering potential consequences. This profile also endorsed affective expressions consisting of anger, frustration, and aggression, as well as depression, anxiety, and stress. Emotional dysregulation featured heavily in response to stressful events. The lives of high IMP MMT clients were often characterized by many adverse experiences, reflecting chaotic and difficult life circumstances. High IMP clients did not preferentially focus their conversations on any specific substance, and also endorsed both positive and negative reinforcement motives for use including enhancement, coping with anxiety, stress, or trauma, and coping with depression.

Clients scoring high in HOP predominantly endorsed sad and depressed affective states. They experienced adverse experiences consisting of health problems and relationship difficulties, and often spoke about opioids and stimulants. The motives for use endorsed by this group tended to involve coping with depression and enhancement. Coping with pain and coping with anxiety, stress, or trauma were also endorsed.

High AS clients largely reported an internalizing profile characterized by anxiety, fear, and avoidance coping. Opioid withdrawal symptoms were often discussed in this

profile, and so were comorbid health problems. In terms of substance use, use of tranquiliser drugs appeared to predominate the content of our interviews, and this use was largely medically motivated (i.e., high AS clients spoke about being prescribed tranquilisers to manage anxiety symptoms). Coping with anxiety, stress, or trauma was the most discussed motive, although coping with depression and enhancement motives were also discussed relatively frequently.

Integration

Table D1 at the end of this section summarizes and integrates the main findings across all component manuscripts. In short, my dissertation sought to validate and extend the Four-Factor Personality Vulnerability Model (Castellanos-Ryan & Conrod, 2012; Conrod, Pihl, et al., 2000) to the MMT setting specifically. When we initially began this project in 2015, we hoped that results would inform the development of personality-targeted interventions in this area. Our results were overall fairly consistent in supporting the use of this personality model among MMT clients, while also highlighting some unique findings specific to the MMT setting.

In Study 1, I demonstrated that the SURPS is a valid instrument for measuring high-risk personality traits among MMT clients, and that these traits are associated with theoretically relevant past 30-day substance use patterns. In Study 2, I examined both the distribution of motives for use across several drug categories (Study 2A) and whether personality further predicts specific motives for use among those who engaged in recent past 30-day use of various drug categories (Study 2B). My findings suggest that personality is related to motives for use in both theoretically relevant and novel ways, highlighting the importance of additional motivational research in clinical populations. In

Study 3, I collected the lived experience of a sub-sample of high-scoring SURPS personality individuals and examined the themes that emerged from these interviews. Consistent with prior theory (Castellanos-Ryan & Conrod, 2012; Conrod, Pihl, et al., 2000), those with elevations in each personality trait endorsed a specific cognitive, affective, and behavioral profile that related to specific motives for substance use and a preference towards specific substances. However, additional themes emerged that were consistent with a population at a later stage of addiction, which struggled with not only the physiological consequences of repeated substance misuse, but also several difficult socioeconomic situations and other related adverse events and life histories. The motivational patterns endorsed across both Studies 2 and 3 (Chapters 4, 6, and 8) were consistent in suggesting that both positive and negative reinforcement motives for use are important in clinical samples, highlighting the importance of conceptualizing substance use behaviours through a multifactorial lens when working with a population at a later stage of addiction.

Table D1. Summary of findings across all manuscripts

Personality	Study 1	Study 2A	Study 2B	Study 3
	Past-30 days correlates	Interactions with motives		Qualitative descriptions
IMP	<ul style="list-style-type: none"> Injection Drug Use* 	Enhancement <ul style="list-style-type: none"> Stimulants (+) Coping-with-Depression <ul style="list-style-type: none"> Main effect (+) Alcohol (+) Opioids (+) Cannabis (-) Coping-with-Withdrawal <ul style="list-style-type: none"> Main effect (+) Opioids (+) 		Experienced trait as: <ul style="list-style-type: none"> Endorsed a range of internalizing (depression, anxiety, stress) and externalizing (anger, frustration, aggression) symptoms Endorsed a range of adverse experiences Endorsed difficulties with response inhibition Substance correlates: <ul style="list-style-type: none"> Referenced all substances equally (no specificity) Referenced both enhancement and coping motives
SS	<ul style="list-style-type: none"> Alcohol Use Cannabis Use Stimulant Use 	Enhancement <ul style="list-style-type: none"> Tranquilisers (+) Social <ul style="list-style-type: none"> Tobacco (+) Conformity: <ul style="list-style-type: none"> Tranquilisers (+) Coping-with-Withdrawal <ul style="list-style-type: none"> Alcohol (+) 		Experienced trait as: <ul style="list-style-type: none"> Thrill seeking, reward sensitive cognitive style Attracted to risk-taking and other thrilling anti-social behaviours Substance correlates: <ul style="list-style-type: none"> Referenced alcohol and opioids Referenced both enhancement and coping motives
HOP	<ul style="list-style-type: none"> Opioid Use Tranquiliser Use* 	Social <ul style="list-style-type: none"> Main effect (-) Cannabis (-) Opioids (-) Expansion <ul style="list-style-type: none"> Main effect (-) Cannabis (-) Coping-with-Anxiety <ul style="list-style-type: none"> Tobacco (-) Alcohol (+) Cannabis (-) Opioids (-) Conformity <ul style="list-style-type: none"> Main effect (-) Opioids (-) Coping-with-Withdrawal <ul style="list-style-type: none"> Cannabis (-) 		Experienced trait as: <ul style="list-style-type: none"> Sadness, Depression Endorsed numerous adverse experiences, primarily health and relationship difficulties Substance correlates: <ul style="list-style-type: none"> Referenced opioids and stimulants Primarily referenced coping with depression motives and enhancement. Other coping motives also present.

Personality	Study 1	Study 2A	Study 2B	Study 3
	Past-30 days correlates	Interactions with motives		Qualitative descriptions
AS	<ul style="list-style-type: none"> Tranquiliser Use 	Enhancement <ul style="list-style-type: none"> Tobacco (+) Social <ul style="list-style-type: none"> Opioids (+) Expansion <ul style="list-style-type: none"> Main effect (+) Tobacco (+) Cannabis (+) Opioids (+) Coping-with-Anxiety <ul style="list-style-type: none"> Main effect (+) Coping-with-Depression <ul style="list-style-type: none"> Main effect (+) Tobacco (+) Cannabis (+) Tranquilisers (+) Conformity <ul style="list-style-type: none"> Main effect (+) Cannabis (+) Tranquilisers (+) Coping-with-Withdrawal <ul style="list-style-type: none"> Main effect (+) 		Experienced trait as: <ul style="list-style-type: none"> Anxiety, Fear, Panic Endorsed avoidance coping strategies Heavily discussed withdrawal effects Substance correlates: <ul style="list-style-type: none"> Referenced tranquilisers Referenced coping with anxiety, stress, and trauma. Also referenced other coping motives and enhancement.
Other findings	Validated 4-factor structure of the SURPS for use with MMT clients. Validated use of the SURPS instrument out-of-the-box.	Motives for use vary significantly by substance even within the same individuals. Internal motives show a mixture of trait and state properties, while external motives mainly have trait properties.		Adverse life experiences predispose and worsen psychological states and symptoms, which in turn relate to addictive behaviours. Multiple motives for use operate within clinical populations, with self-medication, withdrawal management, and enhancement motives most heavily endorsed.

Note: *denotes that the finding was present in the “summed” model only. (+) and (-)

indicate the direction of an effect.

Discrepancies Between Manuscripts

Although both Study 2B and Study 3 support the finding that motives for use in clinical populations include both internalizing and externalizing dimensions, some discrepancies emerge when examining the results of Study 2B and the hypothesized relationships emerging from Study 1 and supported by Study 3. When examining Study

2B, it is unclear why motives for use in AS and HOP appear to be not only diffuse but also largely in opposite directions relative to each other. A possible explanation for this divergent finding may relate to low statistical power in certain subgroups described by the modeled interaction effects.

Indeed, although the analytical method I developed allowed for the analysis of unbalanced data by modeling both zero-inflated and conditional processes, the introduction of interaction terms nevertheless requires a large sample. Indeed, models with interaction terms showed poorer fit when compared to main effect models, yet were reported nevertheless due to theoretical interest. Although statistical power is not as much of a problem in Bayesian statistics as it would be in a frequentist design (i.e., because we can quantify the level of uncertainty, thus lesser power simply results in wider credibility intervals rather than inflated Type II error), it is nevertheless true that drug classes with lower prevalence had fewer participants. Therefore, certain drug classes had less personality data through which the model could use to make predictions. Moreover, estimates derived for the main effects of personality will be influenced by substances with more data (namely Tobacco, followed by Cannabis), which is why examining interaction effects was important despite the certainty of being underpowered. However, endorsing motives for use subsumes a prior conditional process (i.e., the individual needs to have used that substance in the past 30-days), which was modeled in Study 1 and is also modeled as the zero-inflated conditional process in Study 2B (examination of those results unsurprisingly shows a replication of the logistical regressions of Study 1 given they were performed on the same participants and data). As such, the motivational patterns across drug categories evidenced in Study 2B are best understood as a

heterogeneous mixture of various overlapping subsamples of individuals using polysubstances that happened to share a common substance at a given point in time. In other words, the range of a particular personality dimension may differ across subsamples of drug categories, particularly when that personality dimension was related to specific forms of substance use. While the model broadly considered variance at the participant level, other sources of random variance was not modeled. Indeed, while I modeled different intercepts for each subject, modeling additional random parameters (e.g., random slopes) was computationally too demanding at this sample size and introduced model convergence errors. These issues could only be fixed by methodological changes through recruitment of a larger sample or using balanced data (i.e., not needing to model a much more complex two-part zero-inflated model). While I believe the findings of Study 2B remain important, particularly those with the highest directional probabilities, future research will need to investigate whether these effects can be replicated in larger samples.

Additionally, a difference between this design and some others in the literature is that each motive was examined individually, without controlling for the influence of other motives. Controlling for the influence of other motives can be problematic, in part due to the high correlation between certain motive pairs. Other motives were not entered as predictors in these analyses for model parsimony given the already large numbers of predictors. The current design demonstrates an unadulterated relationship between personality and specific motives and may therefore yield different results to designs that co-vary other motives as predictors.

Alternatively, discrepancies between the motivational findings from Study 2B and 3 may simply be related to differences in data collection methodology (quantitative versus qualitative). Although the motivational findings from Study 3 are most consistent with the Four-Factor Personality Vulnerability Model (Castellanos-Ryan & Conrod, 2012; Conrod, Pihl, et al., 2000), it is important to recognize that Study 3 recruited a limited set of individuals high on a respective SURPS trait.

Theoretical Implications

Pihl and Peterson's (1995) underlying four-factor model was expanded by Castellanos-Ryan & Conrod (2012) to include personality's contribution to different etiological addiction models. My dissertation's contribution was to expand and test this model to the *maintenance* of addiction behaviours by testing the theoretical relationships between SURPS personality traits and substance use/substance use motives in a population of individuals in treatment for opioid use disorder (i.e., MMT clients). In turn, I will speak to the implications of my findings for the both the four factor personality model and the motivational model of substance use.

Four Factor Personality Vulnerability Model

As reviewed in Chapter 1, the majority of the extant literature on the SURPS and the Four-Factor Personality Model (Castellanos-Ryan & Conrod, 2012; Conrod, Pihl, et al., 2000) has focused on adolescents and young adults, providing convincing evidence that personality is involved in the development of substance use behaviours and their associated comorbidities. However, less is known about the role of personality in the maintenance of addictive behaviours. Mechanistic models of addiction (Koob & Volkow,

2010) suggest that the addiction cycle is composed of three interactive cycles of binge/intoxication, withdrawal/negative affect, and preoccupation/anticipation. Through this model, addiction is conceptualized as both a compulsive disorder and an impulse control disorder. Continued use of substances is thought to sensitize the brain's "anti-reward systems" and lead to a progression from positive reinforcement (binge/intoxication stage) to negative reinforcement (withdrawal/negative affect stage) use (Koob et al., 2014). A model developed and tested at earlier stages of addiction may not necessarily generalize to a population at a later stage of addiction. However, my results suggest that the personality traits measured by the SURPS continue to be important in predicting substance use, substance use motivations, and correlated outcomes even at this later stage.

To date, only a few studies (Hopley & Brunelle, 2016; Kaminskaite et al., 2020; Long et al., 2018; Schlauch et al., 2015) have investigated the psychometric properties of the SURPS in different clinical samples of people who use substances at a later stage of addiction. My dissertation joins this body of work to demonstrate that the SURPS is a valid instrument in a clinical population and extends the Four Factor Personality Model (Castellanos-Ryan & Conrod, 2012; Conrod, Pihl, et al., 2000) to the MMT context. My results suggest that SURPS personality traits can predict theoretically relevant patterns of substance use among MMT clients, are associated with varying motivational patterns of use, and are qualitatively associated with specific cognitive behavioral profiles.

Hopelessness

HOP is thought to predispose to a pattern of substance use focused on reducing negative affect, characterized by a preference towards substances with analgesic effects

(e.g., alcohol and opioids). and internally motivated by depression coping motives (Castellanos-Ryan & Conrod, 2012; Conrod, Pihl, et al., 2000). Individuals high in HOP are said to be more sensitive to punishment, and more likely to be diagnosed with a mood disorder (Conrod, Pihl, et al., 2000). Consistent with this model, HOP was shown to be associated with higher rates of opioid use disorders in community recruited substance dependent women (Conrod, Pihl, et al., 2000), with opioid misuse via depressive symptoms in adolescents (Stewart, Chinneck, et al., 2021), and with opioid use in first year university students (Chinneck et al., 2018). As such, I hypothesized that HOP would be important in predicting opioid use in a population of individuals in treatment for opioid use disorder. Although both Long et al. (2018) and Schlauch et al. (2015) unexpectedly failed to find evidence of an association between HOP and opiates when examining inpatient substance users and a community recruited sample of non-treatment seeking substance users, respectively, this was not the case in my studies that focused specifically on individuals in MMT for opioid use disorder. My dissertation suggests that HOP represents a unique pathway to opiate misuse in MMT clients (even when controlling for methadone dosage), as earlier demonstrated among adolescents and young adults. Among MMT clients stabilized on methadone, HOP was linked to topping up with opioids and a diffuse motivational profile consisting of negative motive endorsement across most motive and substance categories.

Schlauch et al. (2015) suggested that in a sample of substance users, HOP may be measuring current symptoms of depression rather than trait-like hopelessness, and that personality traits such as neuroticism can vary significantly among substance dependent participants. In Long et al.'s (2018) study, HOP was related to depressive symptoms

measured by the Beck Depression Inventory-II (BDI-II; Beck et al., 1996). As we did not measure depressive symptoms, and my design is cross-sectional, we can not test this hypothesis statistically. Nevertheless, in qualitative interviews in Study 3 (Chapter 8), HOP clients certainly endorsed numerous depressive symptoms and coping with depression motives featured prominently in their descriptions of substance use events.

Indeed, high HOP clients described a depressogenic cognitive and affective style, and a wide range of motives for use including enhancement motives that could more aptly be described as “coping with anhedonia” rather than a pure pursuit of pleasure generally envisioned by “positive reinforcement”. As such, it can be interpreted that individuals high in HOP may be self-medicating their lack of positive affect through their use of substances with affect enhancement properties (e.g., stimulants, opioids). Future motives research may consider adding items that specifically tap into self-medication of low positive affect.

Anxiety Sensitivity

AS is posited to represent a negative reinforcement pathway to substance use due to a fear of anxiety-related sensations and a desire to self-medicate these uncomfortable sensations. Individuals high in AS are thought to be more likely to misuse substances with anxiolytic properties, such as tranquiliser drugs (Conrod, Pihl, et al., 2000). My dissertation confirms this association among MMT clients, providing support for a negative reinforcement pathway to substance misuse in higher AS clients. This is most clearly supported by the qualitative data, which heavily endorsed coping with anxiety motives for use in high AS clients and a cognitive behavioral profile consisting of anxiety, fear, and panic symptoms and avoidance coping strategies. In contrast, although

the quantitative data suggested a main effect of AS for coping with anxiety motives, it also suggested a non-specific pattern of motives for use for AS through a generalized positive endorsement of several motives across multiple substance categories. This unexpected finding warrants further inquiry.

Similarly to Schlauch and colleagues (2015), we did not find specificity towards either coping with anxiety or coping with depression motives in relation to AS (in the quantitative Study 2B), supporting their conclusion that AS may be related to coping with negative affect more broadly among clinical populations with higher rates of psychiatric comorbidities (Connor et al., 2014; Thornton et al., 2012). AS, as measured by the Anxiety Sensitivity Index-3 (ASI-3; S. Taylor et al., 2007), is a construct thought to represent three different facets: physical, cognitive, and social AS concerns. It is possible that SURPS-AS, which only focuses on the physical concerns facet of AS, fails to capture the hypothesized relationship to recent coping-with-anxiety motives in a sample MMT clients. The relatively high correlation between AS and IMP in this sample also warrants further attention, and may partially explain why AS showed a diffuse profile of motives for substance use typically reported among high IMP individuals in other SURPS validation studies (e.g., Woicik et al., 2009). However, we were able to replicate previous reports suggesting AS is associated with conformity motives for cannabis (Comeau et al., 2001; Hecimovic et al., 2014), and extended this result to tranquilisers.

Interestingly, we were able to show a main effect of AS for coping with withdrawal motives, suggesting that AS is associated with a vulnerability to using substances generally to cope with the unpleasant physiological effects of withdrawal states. The fear of withdrawal symptoms was also often discussed in qualitative

interviews with high AS MMT clients in Study 3. Indeed, AS is thought to be negatively related to distress tolerance (i.e., the ability to tolerate negative emotions such as those experienced during withdrawal; Zvolensky et al., 2010), which may account for the long-recognized role of “detoxification fear” as a maintaining factor in opiate dependence (Hall, 2009; Schumacher et al., 1992). AS has been linked with opioid misuse in adults with chronic pain (Rogers et al., 2019, 2020). AS is also associated with heroin use in clients attending inner-city substance use treatment programs (Lejuez et al., 2006) and has been implicated as a unique predictor for treatment dropout (Lejuez et al., 2008). These prior findings and my dissertation results fit with recent research showing AS is a unique risk factor for greater fear of withdrawal and greater subjective withdrawal severity among OAT clients (Baxley et al., 2019). My findings add to the literature in suggesting that high AS MMT clients may be particularly susceptible to detoxification fears and may use a variety of substances to cope with or avoid unpleasant withdrawal-related arousal sensations.

Sensation Seeking

SS is characterized by a need for stimulation, and a willingness to take risks to have novel and varied experiences (Zuckerman, 1971). Because individuals who are high in SS are thought to be pharmacologically more sensitive to the rewarding properties of substances (Castellanos-Ryan & Conrod, 2012), SS has mostly been associated with enhancement motives. SS has been associated with alcohol use and alcohol use disorders (Conrod, Pihl, et al., 2000; Long et al., 2018; Schlauch et al., 2015), cannabis use (Mahu et al., 2015), stimulant use (Chinneck et al., 2018; Long et al., 2018; Stewart, Chinneck, et al., 2021), and opioid use (Long et al., 2018; Schlauch et al., 2015). My dissertation

suggests that among MMT clients, SS is linked to recent alcohol, cannabis, and stimulant use. MMT clients frequently discussed alcohol and opioid use in qualitative interviews. They endorsed coping with withdrawal motives for alcohol, consistent with this trait's vulnerability to alcohol use disorders (Conrod, Pihl, et al., 2000; Long et al., 2018). They further endorsed enhancement motives for tranquilisers, consistent with suggestions that they may be using tranquilisers drugs to enhance the effects of methadone or other opioids (J. D. Jones et al., 2012; Mateu-Gelabert et al., 2017). Additionally, in qualitative interviews, they reported a cognitive behavioral profile consisting of thrill seeking and engaged in risk taking behaviours.

However, somewhat unexpectedly in relation to theory (Conrod, Pihl, et al., 2000), high SS clients also reported exposure to trauma and endorsed depressive symptoms. Among MMT clients, SS may not represent a pure positive reinforcement pathway to substance use, as both enhancement (e.g., tranquilisers) and coping motives (in qualitative interviews) appeared to be endorsed. Although the Four-Factor Personality Vulnerability model (Castellanos-Ryan & Conrod, 2012) asserts that SS is not associated with any specific mental health disorders, this may not hold true for a population at a later stage of addiction, where continued lifetime risk taking behaviours carries both increased exposure to adverse life consequences, violence, and trauma. This is specifically known as the "high-risk hypothesis", which suggests that substance use may increase risk for exposure to traumatic events through exposure to high-risk situations and/or impairment in the detection of risk in the environment (Haller & Chassin, 2014).

However, there is ample epidemiological evidence to suggest a bi-directional relationship between trauma and addictive disorders (Borges et al., 2021; Cottler et al.,

1992; Dworkin, 2020; Keyes et al., 2011; Kilpatrick et al., 1997; Konkoly Thege et al., 2017; McFarlane, 1998; Stewart et al., 1998; Stewart & Conrod, 2003). Exposure to traumatic events may lead to using substances as a means to cope (i.e., self-medication hypothesis), and in turn using substances increases the chances of further exposure to trauma (high-risk hypothesis; Haller & Chassin, 2014). Alternatively, risk factors such as personality traits may represent a shared pathway to both PTSD and SUDs, known as the “shared vulnerability hypothesis” (Stewart & Conrod, 2003).

Consistent with a “shared vulnerability hypothesis” (Stewart & Conrod, 2003), SS may represent a unique pathway to both substance misuse and trauma exposure. Increased risk-taking tendencies in turn increase exposure to trauma (i.e., high-risk hypothesis) and drive coping-mediated substance use (i.e., self-medication hypothesis), as evidenced in one interview with a thrill seeker who sought an exciting but ultimately traumatic career in the coast guard. Additionally, increased susceptibility to alcohol/drugs reduces risk appraisal and in turn increases exposure to traumatic events, as evidenced in qualitative interviews suggesting high SS individuals engaging in high-risk behaviours (e.g., fights, dangerous driving) after engaging in substance use. Because this relationship was only evident in qualitative interviews, further research will need to carefully examine whether SS in OAT clients is related to exposure to traumatic events in quantitative designs controlling for other personality traits.

Impulsivity

IMP is associated with deficits in behavioral inhibition, enhanced emotional reactivity, and poor planning (Vassileva & Conrod, 2019; Woicik et al., 2009). It is associated with diffuse motives for use, with availability and difficulty inhibiting

behavior likely explaining use (Hecimovic et al., 2014; Schlauch et al., 2015; Woicik et al., 2009). Although linked with substance use generally, IMP as measured by the SURPS has been most reliably associated with stimulant use (Chinneck et al., 2018; Long et al., 2018; Schlauch et al., 2015). In clinical populations, it has also been associated with opioid use (Long et al., 2018; Schlauch et al., 2015). Unexpectedly, we were not able to replicate this hypothesized relationship to stimulants. It is possible that long-term participation in MMT may attenuate the relationship between IMP and stimulant use due to methadone's sedative effects (Webster, 2013). Our failure to replicate this effect warrants further investigation in other OAT samples. However, among individuals who used stimulants, IMP predicted higher enhancement motives, as theorized. Additionally, we showed for the first time that IMP is related to a specific form of substance misuse with more immediate effects yet higher risks, namely injection drug use (Degenhardt et al., 2006; El-Bassel et al., 2014).

In my qualitative study, high IMP participants described a range of externalizing symptoms (e.g., anger, aggression, anti-social behaviour) as well as internalizing symptoms (e.g., depression, anxiety), involvement in adverse events, and difficulties with response inhibition and planning. This is consistent with the literature highlighting IMP's involvement in disorders of behavioral under control (Vassileva & Conrod, 2019), such as antisocial personality disorder (Conrod, Pihl, et al., 2000; Long et al., 2018) and attention-deficit hyperactivity disorder (Chinneck et al., 2018; Long et al., 2018; Stewart, Chinneck, et al., 2021).

Like SS, high IMP traits in MMT clients may confer a non-specific risk to substance misuse comprised of both positive and negative reinforcement. This is

consistent with a wide literature reporting IMP being associated with affective disorders generally and depression specifically (Corruble et al., 2003; Peluso et al., 2007; Swann et al., 2008). IMP may lead to difficulties in living (e.g., impulsive decisions leading to catastrophic outcomes) through which depression symptoms are eventually expressed (Granö et al., 2007). In support of this hypothesis, SURPS-IMP was related to depressive symptoms in a clinical sample of non-treatment seeking substance users (Long et al., 2018). Further, my results suggest that coping with depression is an important motive for high IMP MMT clients; and that it is specifically positively related to alcohol and opioids, substances which have analgesic/antidepressant properties (Ciccocioppo et al., 1999; Gray, 1982; Rouine et al., 2018; Saxena & Bodkin, 2019; Wolfe et al., 2016).

Like with AS, IMP was uniquely related to a vulnerability towards coping with withdrawal motives, particularly when examining opioid use. Intolerable affective states, such as withdrawal (or distress/sadness), may lead high IMP individuals to take impulsive actions as a means to cope, a facet of impulsivity known as negative urgency (Vassileva & Conrod, 2019; Zorrilla & Koob, 2019). Poor distress tolerance skills may lead high IMP individuals to act quickly in response to negative urgency, potentially explaining the associations of IMP to coping-with-withdrawal, enhancement, and coping-with-depression motives, and injection drug use.

Motivational Model for Substance Use

We developed a novel measure designed to quickly collect motivational data in polysubstance use contexts, and showed that motives for use differ by substance, even within the same group of people who use multiple substances. More recently, this measure has been slightly revised and further validated for measuring co-occurring

alcohol and cannabis motives (Bartel et al., 2022). Consistent with prior attempts to differentiate between coping-with-anxiety and coping-with-depression (V. V. Grant et al., 2007), we were able to show some specificity with tobacco and tranquilisers being endorsed for coping-with-anxiety more frequently than for coping-with-depression motives, logically consistent with their respective pharmacological effects. However, predictions for differentiating between these two forms of coping motives were not always supported in terms of specificity, which may be an issue relating to the use of a single-item measure which did not allow to fully distinguish between these two highly correlated constructs. Although the use of a single-item measure was necessary to balance against feasibility concerns when measuring motives for multiple substances within the same individuals, future research will need to investigate whether the limited specificity we observed here can be replicated and whether it has clinical utility in predicting particular outcomes.

Beyond the contributions to the motivational literature specific to each of the four traits described above, my dissertation also provided a preliminary answer to the often debated question of whether motivational dynamics of substances are specific to each substance or whether they are stable internal constructs (Cooper et al., 2016). To my knowledge, this was the first study to directly compare motive endorsement across six classes of drugs within the same sample, which is important for estimating the common and unique dynamics that underlie substance use. Our results suggested that most motives differ across substances in similar ways to how drinking motives differ across different situational contexts (i.e., about 50% of within-person variability in alcohol use is accounted for by different situations; Demers et al., 2002; Kairouz et al., 2002). In our

data, the exception appears to be two external motives, i.e., social motives and especially conformity motives, which appear to be most trait-like in regard to their stability across substances. This has important implications for prevention and intervention strategies. For example, if misuse is primarily driven by social or conformity motives, these can be targeted in universal intervention strategies (i.e., non-specific substance programming); whereas use driven by other motives may require both universal and substance-specific programming.

Additionally, we were able to rank each motive across all six categories of substance in terms of their prominence. This analysis demonstrated that use of a single substance is motivated by multiple motives, sometimes equally strongly by more than one motive. Indeed, coping and enhancement motives play a key role in the motivational dynamics of most recent substance use behavior among a population at a later stage of addiction. Importantly, withdrawal motives were prominently endorsed for both opioids and tobacco, highlighting the importance of withdrawal management in the treatment of both opioid (Kosten & Baxter, 2019) and nicotine use disorder (Rigotti et al., 2022).

Although not included as an item in my motives measure, several participants in qualitative interviews endorsed using to cope with stress or to relax. Many have highlighted living through difficult and stressful experiences, including housing insecurity, poverty, interpersonal stressors, stigma, health difficulties, and many more. Given the abundant literature linking stress to the precipitation and maintenance of substance use (Keyes et al., 2011; Koob et al., 2014; Kreek & Koob, 1998; Oswald et al., 2021; S. B. Taylor et al., 2014; Wiss, 2019), it is curious that none of the existing motive measures seem to include a tension-reduction motive or more specifically a “coping with

stress” motive. Tension reduction models (Cappell & Greeley, 1987), which focus on the physiological experience of high arousal states induced by stress, have largely been supplanted by more nuanced affect regulation models (Cox & Klinger, 1988) which focus on the subjective experience of emotion (e.g., anxiety, depression; Dvorak et al., 2018). There likely is some overlap between “coping with stress” and the other coping motives (i.e., coping with anxiety, depression, and withdrawal), as each of those corresponding affective states can be interpreted as a “stressor” and would fall under the umbrella of negative reinforcement motives. However, while affective states such as anxiety and sadness may be linked to the physiological states of stress or tension, they are appraised differently from stress (Dvorak et al., 2018; Zautra, 2003). While stress may be linked to emotion, it is also associated with specific physical (i.e., tension), cognitive (Lazarus & Folkman, 1984), and biological components (Yaribeygi et al., 2017). Experiencing withdrawal, housing insecurity, or other adverse events and stressors may potentially trigger “coping with stress” motives. Thus, while coping with anxiety and coping with depression reflect a desire to cope with a subjective affective state, coping with stress motives would reflect a different cognitive appraisal where a particular state or life event acts as an activating stressor. Given recent reports of AS, HOP, and IMP being associated with alexithymia (i.e., a difficulty identifying and describing emotions) in community recruited substance users (Long et al., 2018), collecting stress-motives (which are more physiological) may provide a more accurate representation of negative reinforcement motives. Future research should consider adding a coping with stress item and examine whether it provides additional predictive value beyond other existing coping motives measures.

Clinical Implications

Personality-Targeted Treatment

Personality is regarded as a trans-diagnostic variable that contributes to both psychiatric and addictive psychopathology (Castellanos-Ryan & Conrod, 2012; Pihl & Peterson, 1995), making it a potentially useful treatment target for highly comorbid conditions. Because integrated treatment for comorbidity is often more effective than therapies targeting separate disorders (Kelly & Daley, 2013), focusing on personality-related risk can allow for the simultaneous treatment of addictive behaviour and comorbid mental health problems common among MMT clients. This is known as “personality-targeted” or “personality-matched” treatment, which has been shown to increase relevance and impact as clients are matched to tailored interventions (Conrod, Stewart, et al., 2000). The most well-known personality-targeted intervention model is PreVenture (see reviews by Conrod, 2016; Edalati & Conrod, 2019), currently delivered as a substance use prevention program. PreVenture contains key components from CBT and Motivational Enhancement Therapy (MET) designed to target psychiatric disorders and coping strategies relevant to each personality trait (e.g., cognitive-behavioral strategies for: dealing with negative autonomic thoughts for HOP; reducing panic symptoms for AS; managing ADHD symptoms for IMP; managing the need to stand out and take risks for SS).

This model may be adapted to address the unique needs of MMT clinics: being able to provide an effective psychosocial treatment option as an adjunct to the medical OAT protocol (Dugosh et al., 2016). As discussed previously, both MMT clinics and clients have expressed interest in this model as an adjunct to pharmacological treatment

(Mahu, Conrod, Barrett, MacIsaac, et al., 2019). My dissertation suggests that the general theoretical model can translate well from the PreVenture literature, although future studies will need to determine the best treatment dose in terms of group composition and number of sessions. While additional research will be needed to confirm the associations between SURPS personality and mental health symptoms (Battista et al., 2013), the following treatment recommendations would likely be useful in developing future treatment manuals:

To reduce their use of opioids while in treatment, MMT clients high in HOP would likely benefit from cognitive-behavioral strategies to address depressogenic thinking and depressive symptoms, as well as learn new strategies to manage or live with pain (e.g., Acceptance and Commitment Therapy [ACT] skills). High AS MMT clients could benefit from skills training in managing anxiety and panic symptoms (e.g., learning to challenge catastrophic thinking, overgeneralization, and avoidance) to reduce their risky use of tranquilisers while on methadone. MMT treatment providers may want to consider monitoring withdrawal symptoms and changes in methadone dosage with AS clients carefully given the increased risk of substance misuse and psychological distress associated with negative affect and physiological arousal states. For both externalizing traits (IMP and SS), consideration will need to be made about adding material about negative reinforcement pathways to substance use. High IMP MMT clients may benefit from cognitive behavioral skills designed to challenge impulsive, aggressive, and antisocial thoughts and behaviours, in addition to strategies for treating depressive symptoms. As with AS clients, MMT providers may consider carefully monitoring withdrawal symptoms and changes in methadone dosage with IMP clients given their

vulnerability to using substances for coping with withdrawal. If my negative urgency substantiation is correct, these clients may further benefit from Dialectical Behavioral Therapy (DBT) interventions designed around building emotional regulation and interpersonal effectiveness skills. In support of this assertion, Blanchard et al. (2020) found that IMP was most strongly correlated with the urgency subscales of the UPPS-P, speculating that IMP-targeted treatments may be more effective if emotion regulation strategies were taught. High SS MMT clients may benefit from cognitive behavioral and motivational enhancement skills to manage their need for stimulation and excitement in ways that focus on minimizing long-term consequences (i.e., harm reduction) and reducing their use of alcohol, cannabis, and stimulants. Trauma-focused psychotherapy skills (i.e., grounding techniques, cognitive re-appraisals of traumatic memories) will likely be relevant to all groups, and particularly relevant for high SS MMT clients given their propensity to experience trauma through their risk taking and substance use. Future studies will need to confirm whether there is an association between SS and PTSD symptoms secondary to the high rates of trauma exposure revealed in their qualitative interviews.

Strengths and Limitations

While specific strengths and limitations corresponding to each study have been discussed in earlier chapters, I will briefly review some general observations as they pertain to the dissertation as a whole or to specific areas worth highlighting. I will first review limitations, and then discuss several important strengths of my dissertation research.

Limitations

My dissertation's results need to be considered with the following general limitations. One of the largest limitations is the cross-sectional design of my studies. Therefore, all my findings are correlational. As alluded previously, personality can change significantly during substance use treatment and after prolonged substance use. As such, future studies should use longitudinal designs to examine the stability of the SURPS traits while undergoing MMT or before initiating MMT (e.g., population tracking or follow-up of a long-term cohort). Moreover, larger samples will also be important to be adequately powered for detecting personality interaction effects among more rarely used substances, or to test mediational models (e.g., personality to motives to substance use). Additionally, although we sampled four different clinics, the results of these four manuscripts are all derived from the same 138 participants (Study 1, 2A, 2B) or a subset thereof (Study 3). As such, the generalizability of these findings may be limited. Independent replication of these effects in different MMT or OAT samples is necessary to increase the confidence of the personality, motives, and substance use links highlighted in this dissertation.

Another methodological limitation is related to the use of retrospective self-report measures, which may lead to underreporting, social desirability bias, or inaccurate reporting. While the reliability of the SURPS has been well demonstrated (Jurk et al., 2015; Woicik et al., 2009), the current body of work did not examine the psychometric properties of the novel motives measure presented. Research suggests that patients generally do not under-report their substance use in naturalist clinical assessment settings (Denis et al., 2012; Zanis et al., 1994), however relying on retrospective self-report

assessment of personality and motives assumes that patients are aware of their inner psychological world and the motives that underlie their behavior (e.g., substance use). Previous studies with the SURPS in clinical populations highlighted the association between several SURPS traits (HOP, IMP, and AS) and alexithymia (i.e., a difficulty identifying and describing one's affective experiences; Long et al., 2018), highlighting that it is possible that some MMT clients may not accurately report on their motives for use due to a lack of awareness. The use of corroborative reports (e.g., by researchers/clinicians observing behavior or collecting collateral information) may enhance the validity of self-reported personality and motive measurements. Further, to combat limitations due to retrospective reporting (i.e., memory biases), substance use motives may be measured more immediately connected to substance use behavior. This can be achieved using ecological momentary assessment techniques (Shiffman et al., 2008). Taken together, these strategies may improve the validity of retrospective self-report data, particularly as it pertains to motive measurement.

Additionally, although we sampled a range of MMT clinics, these findings may not translate to other forms of OAT beyond methadone (e.g., buprenorphine/naloxone). As the clinical guidelines in Canada have shifted from MMT towards buprenorphine/naloxone (Bruneau et al., 2018), certain important differences are worth mentioning between the two treatments. Although both are efficacious treatments, buprenorphine/naloxone has a better safety profile, decreased risk of overdose, and causes less analgesia and euphoria when compared with methadone (Bonhomme et al., 2012; Whelan & Remski, 2012). Because of the improved safety profile, another advantage of buprenorphine/naloxone is more flexible at-home dosing schedules (Dunlap

& Cifu, 2016), which can reduce stigma and increase access to treatment (Bonhomme et al., 2012; Hill et al., 2015). However, because buprenorphine/naloxone is largely self-administered, clients may purposely elect to use it intermittently (Bonhomme et al., 2012), which means withdrawal management may be less consistent for some.

Methadone is also superior for treating patients who are severely opioid addicted, as it activates the mu receptor at higher affinity (Bonhomme et al., 2012; Dunlap & Cifu, 2016; Whelan & Remski, 2012). This difference between the two OATs may influence endorsed withdrawal motives for some (i.e., such that those who are more severely dependent on opioids might report more withdrawal symptoms when on buprenorphine/naloxone). Finally, because buprenorphine/naloxone has an improved side-effect profile (e.g., less sedation and euphoria), this may potentially affect the endorsement of coping and enhancement motives, respectively. Further, Buprenorphine/naloxone also may block other opiate analgesics in pain treatment (whereas methadone is highly effective in pain treatment; Bonhomme et al., 2012), which may affect the endorsement of pain coping motives. Future research will need to investigate whether the SURPS is an adequate clinical instrument in other OAT settings and for clients taking other forms of OAT besides methadone.

Another major limitation is that we did not measure mental health symptoms (e.g., depression, anxiety, trauma, personality disorders, substance use disorders) or correlated personality constructs (e.g., other measures of IMP or SS). Although the later omission was primarily due to reducing participant burden, it would have been useful to have additional data on the former to investigate theoretical path models (i.e., personality → mental health symptoms → motives → substance use). Having additional measures of

different personality traits would have been useful for providing additional construct validity to the SURPS and potentially investigate whether new items need to be integrated into the scale which would better fit a population at a later stage of addiction. These measures could include the Anxiety-Sensitivity Index-3 (ASI-3; S. Taylor et al., 2007), the Barratt's Impulsiveness Scale-11 (Patton et al., 1995; Reise et al., 2013), the Urgency, Premeditation, Perseverance, Sensation Seeking, Positive Urgency (UPPS-P) Impulsive Behavioral Scale (Whiteside & Lynam, 2001), and the Sensation-Seeking Scale (SSS; Zuckerman, 1971, 2007; Zuckerman et al., 1964).

Moreover, because we attempted to stick as closely as possible to the five-factor DMQ-R (V. V. Grant et al., 2007), we omitted the measurement of other important motives which should be included in future revisions of our VAS motives measure. Examples include motives for coping with anhedonia, coping with pain, helping with sleep, coping with traumatic memories, and tension reduction (i.e., coping with stress; using to relax). The lack of a coping with pain motive is a particular weakness given that this is an opioid use disorder sample where rates of comorbid pain disorders are high (Dennis et al., 2015; Dowell et al., 2016). We also did not measure dependence levels (for a review of different measures of addiction propensity and severity, see Conway et al., 2010) or withdrawal experiences (e.g., the Clinical Opiate Withdrawal Scale [COWS]; Wesson & Ling, 2003), which would have been useful particularly when interpreting coping-with-withdrawal motives.

Interpretations from the qualitative study are limited by the design of the interview guide, which focused primarily on extracting content specific to manual development. Future qualitative studies in this area may benefit from being more open

ended, and from having both participants and interviewers be blind to group allocation to minimize bias. Additionally, because certain personality groups appear to be less talkative than others (e.g., AS), recruitment for those subgroups may need to increase to achieve saturation. We had a difficult time meeting our recruitment goal of 20 for this study, given the sometimes-transitory nature of this population, so future qualitative studies will need to be mindful of recruitment challenges. Linked to this limitation is that we needed to invite individuals who were high on more than one trait to meet our recruitment target. This latter limitation highlights a more general weakness of the Four-Factor Personality Vulnerability Model (Castellanos-Ryan & Conrod, 2012; Conrod, Pihl, et al., 2000): individuals with multi-personality membership are understudied. Although our sample not being entirely homogeneous in terms of personality elevation is realistic to the population and therefore more generalizable, it provides additional noise to our qualitative interpretations given the overlap between groups in levels of the four traits. Provided that the goal is to isolate the unique contributions of each trait, future qualitative studies will need to plan to oversample to recruit enough “single-class membership” participants.

Strengths

My dissertation also has several important strengths. First, I wish to highlight the importance of mixed-method studies, particularly when developing or extending an existing theoretical model to a new population. Qualitative studies can inform novel research questions and guide the interpretation of quantitative results by bringing forward the voice and experiences of people with lived and living experience (PWLLE; Cornwall & Jewkes, 1995). Second, my dissertation makes several important contributions to the

literature by: (1) extending the use of the SURPS to MMT clients, (2) attempting to integrate the motivational model of substance use in a polysubstance context, and (3) developing a novel and brief motives measure.

Third, although a sample of 138 clients is a modest sample size, it is a sizeable sample considering this is a clinical population spread across four different clinics. Data collection for this study consisted of a collaborative effort between teams located in different provinces which coordinated in different languages, and the fact that we succeeded speaks highly of the efforts made by a small but dedicated group of researchers.

Finally, I used complex and advanced statistical methods (various hierarchical Bayesian models) to offset the limitations of my smaller sample size and increase the interpretability of my data. The use of Bayesian methods here allowed me to fully quantify the uncertainty around each parameter and make probabilistic interpretations of various estimates (Bürkner, 2018; Kruschke & Liddell, 2017; Rouder, 2014). I was able to implement a complex two-part linear mixed model to solve the problem of unbalanced datasets, which is a common challenge in polysubstance use contexts, and provided a blueprint for how such data may be analyzed in future. I also developed a novel method of partitioning trait and state variance within a Bayesian framework. Finally, I was able to combine both content and thematic analysis to quantify endorsement of various themes, therefore combining both quantitative and qualitative methods.

Directions for Future Research

This dissertation represents an initial foray into the examination of the Four Factor Personality Model (Castellanos-Ryan & Conrod, 2012; Conrod, Pihl, et al., 2000)

to MMT clients. In addition to the suggestions made throughout this chapter and in previous manuscripts, future research can extend and improve our understanding of the role of personality in addictive behavior among clinical populations. First, this study focused on MMT – as MMT was the most common form of OAT when this study was originally designed. As discussed previously, it is therefore unknown whether the findings of this dissertation will translate to other forms of OAT, such as Buprenorphine/naloxone, which is now the recommended gold standard treatment in Canada (Bruneau et al., 2018).

Second, related to the timing of these results, several important cultural and political changes have taken place since this data was collected. First, future studies will need to consider the unknown ways in which the COVID-19 pandemic has shaped the opioid epidemic landscape. It is possible that substance use patterns and motives for use could have shifted in the face of such cultural and socio-political changes. Indeed, a recent study of MMT clients in Wuhan reported changes in substance use patterns and increased drug cravings when comparing pre- and post-pandemic data (Liu et al., 2021). Moreover, recent qualitative studies suggest that pandemic fears reduced social connection, access to housing, harm reduction, and medical care services - leading some to use drugs alone more frequently, changing their patterns of consumption, or increasing their use to make up for lost activities (Galarneau et al., 2021). Second, Canada has now legalized cannabis, which appears to have changed substance use patterns in some populations (e.g., chronic pain; Geoffrion et al., 2021), but not in others (e.g., OAT clients; Rosic et al., 2021). The results of this dissertation as they pertain to cannabis will need to be replicated in future studies. Finally, relating more broadly to cultural considerations, these results need to be replicated in samples outside of North America,

particularly given recent efforts to translate the SURPS in a variety of different languages (Castonguay-Jolin et al., 2013; Chandrika Ismail et al., 2009; Kaminskaite et al., 2020; Long et al., 2018; Omiya et al., 2015; Robles-García et al., 2014; Siu, 2011).

Third, the findings of this study are cross-sectional and need to be replicated in longitudinal designs. Although prospective and developmental research with the SURPS implicates that these personality traits develop prior to substance use initiation and predict escalation in substance use over time (Conrod, 2016; Conrod & Nikolaou, 2016), because of the cross-sectional nature of my findings, my dissertation can only suggest that personality is implicated in the maintenance of addictive behavior. Additionally, because most of the research with the SURPS and motives focused on young samples, relatively little is known about the stability of the SURPS personality factors and motives for use in adults. For example, the SURPS showed good 12 month (Krank et al., 2011) and 18 months (Castellanos-Ryan et al., 2013) reliability among youth, similar to other personality traits. Although personality traits are thought to be relatively stable across the lifespan (McCrae & Costa, 1994), some change still occurs in the higher order traits (Roberts et al., 2006; Roberts & DelVecchio, 2000) and it is not known how this may translate to the lower-order traits measured by the SURPS, particularly within people who use substances (e.g., see Quinn & Harden, 2013). The same questions remain respective to motives, which vary significantly across contexts (Demers et al., 2002; Kairouz et al., 2002). The ideal design would be developmental, using a population-based approach, and measure personality and other constructs of interest across multiple developmental periods. A more realistic design allowing the testing of casual effects would include intervention research. Indeed, demonstrating that personality-targeted

interventions can reduce or improve outcomes of interest (e.g., frequency of use, quantity of use, polysubstance use patterns, injection drug use, quality of life, comorbid psychopathology) would offer stronger evidence of the role of personality in the maintenance of addictive behavior.

Fourth, as previously mentioned, future studies should investigate not only additional correlated personality constructs, which has the potential to update the item content of the SURPS to be more sensitive to the unique characteristics of various clinical populations, but also include measures of mental health symptoms to further our understanding of the relationship between substance use, personality traits, and psychiatric disorders (ideally, in prospective or intervention designs). Equally important is the inclusion and measurement of the additional motives highlighted above (e.g., coping with pain, tension reduction, coping with traumatic memories) to further our understanding of motivational dynamics in clinical populations.

Fifth, larger samples will be necessary to analyze substance use patterns more finely (e.g., frequency, quantity, medically sanctioned vs. misuse, pure drug categories rather than combined). Larger samples are also required for investigating interaction effects. Given that this is a clinical population, large recruitment is difficult from a practical perspective, but can be achieved through multi-site collaboration of national networks of researchers, e.g., through initiatives such as the CIHR-funded Canadian Research Initiative in Substance Misuse (CRISM; see <https://crism.ca/>).

Finally, future studies need to consider developing personality-targeted treatments to respond to this pressing need for effective and brief interventions in the OAT setting. The findings of my dissertation prompted us to apply for and successfully secure a CIHR-

funded grant (Stewart, Conrod, et al., 2021) to develop and pilot personality-targeted interventions for MMT settings. Ultimately, this future research should provide greater clarity on the role of personality in the maintenance of addictive behaviors among MMT clients, as we are considering all the limitations listed above in the design of this future study.

Conclusions

In conclusion, my dissertation sought to validate the Four Factor Personality Vulnerability model (Castellanos-Ryan & Conrod, 2012; Pihl & Peterson, 1995) to the MMT context. In so doing, I found that (1) the SURPS is a valid instrument among MMT clients. Further, I found that personality is associated with specific (2) forms of substance use, (3) substance use motives (generally and for specific drugs), and (3) cognitive behavioral profiles. Specifically, I found that HOP predicted opioid use, was negatively associated with most motives for use, and fit a cognitive behavioral profile characterized by depression and negative reinforcement motives for use. AS predicted tranquiliser use, showed a diffuse pattern of motive endorsement, and fit a cognitive behavioral profile characterized by anxiety and panic symptoms, avoidance coping, and coping with anxiety motives for substance use. IMP was associated with injection drug use, coping with depression and withdrawal motives, and fit a cognitive behavioral profile involving both externalizing and internalizing psychopathology. SS predicted alcohol, cannabis, and stimulant use, enhancement motives for tranquilisers and withdrawal motives for alcohol, and fit a cognitive behavioral profile characterized by thrill seeking and reward sensitivity with both positive and negative reinforcement motives for use. Taken together, these results extend the Four Factor Personality Vulnerability model to the MMT context

and suggest the possible utility of adapting and testing personality-targeted interventions (Conrod, 2016; Conrod et al., 2006) as a much-needed adjunct to OAT.

REFERENCES

- Adinoff, B., Rilling, L. M., Williams, M. J., Schreffler, E., Schepis, T. S., Rosvall, T., & Rao, U. (2007). Impulsivity, neural deficits, and the addictions: The “oops” factor in relapse. *Journal of Addictive Diseases, 26*, 25–39.
https://doi.org/10.1300/J069v26S01_04
- Albein-Urios, N., Martinez-González, J. M., Lozano, óscar, Clark, L., & Verdejo-García, A. (2012). Comparison of impulsivity and working memory in cocaine addiction and pathological gambling: Implications for cocaine-induced neurotoxicity. *Drug and Alcohol Dependence, 126*(1–2), 1–6.
<https://doi.org/10.1016/J.DRUGALCDEP.2012.03.008>
- Albein-Urios, N., Martinez-Gonzalez, J. M., Lozano, Ó., Moreno-López, L., Soriano-Mas, C., & Verdejo-Garcia, A. (2013). Negative urgency, disinhibition and reduced temporal pole gray matter characterize the comorbidity of cocaine dependence and personality disorders. *Drug and Alcohol Dependence, 132*(1–2), 231–237.
<https://doi.org/10.1016/J.DRUGALCDEP.2013.02.008>
- Ali, A., Carré, A., Hassler, C., Spilka, S., Vanier, A., Barry, C., & Berthoz, S. (2016). Risk factors for substances use and misuse among young people in France: What can we learn from the Substance Use Risk Profile Scale? *Drug and Alcohol Dependence, 163*, 84–91. <https://doi.org/10.1016/J.DRUGALCDEP.2016.03.027>
- Amato, L., Minozzi, S., Davoli, M., Vecchi, S., Ferri, M. M. F., & Mayet, S. (2008). Psychosocial and pharmacological treatments versus pharmacological treatments for opioid detoxification. *Cochrane Database of Systematic Reviews, 4*.
<https://doi.org/10.1002/14651858.CD005031.pub3>
- Arbeau, K. J., Kuiken, D., & Wild, T. C. (2011). Drinking to enhance and to cope: A daily process study of motive specificity. *Addictive Behaviors, 36*(12), 1174–1183.
<https://doi.org/10.1016/j.addbeh.2011.07.020>
- Babor, T. F., & Caetano, R. (2006). Subtypes of substance dependence and abuse: Implications for diagnostic classification and empirical research. *Addiction, 101*(SUPPL. 1), 104–110. <https://doi.org/10.1111/j.1360-0443.2006.01595.x>
- Babor, T. F., Hofmann, M., DelBoca, F. K., Hesselbrock, V., Meyer, R. E., Dolinsky, Z. S., & Rounsaville, B. (1992). Types of alcoholics, I. Evidence for an empirically derived typology based on indicators of vulnerability and severity. *Archives of General Psychiatry, 49*(8), 599–608.
<https://doi.org/10.1001/archpsyc.1992.01820080007002>
- Bao, Y. P., Liu, Z. M., Epstein, D. H., Du, C., Shi, J., & Lu, L. (2009). A meta-analysis of retention in methadone maintenance by dose and dosing strategy. *The American Journal of Drug and Alcohol Abuse, 35*(1), 28–33.
<https://doi.org/10.1080/00952990802342899>

- Barrett, E. L., Newton, N. C., Teesson, M., Slade, T., & Conrod, P. J. (2015). Adapting the personality-targeted Preventure program to prevent substance use and associated harms among high-risk Australian adolescents. *Early Intervention in Psychiatry*, *9*(4), 308–315. <https://doi.org/10.1111/eip.12114>
- Barrett, S. P., Gross, S. R., Garand, I., & Pihl, R. O. (2005). Patterns of simultaneous polysubstance use in Canadian rave attendees. *Substance Use and Misuse*, *40*(9–10), 1525–1537. <https://doi.org/10.1081/JA-200066866>
- Bart, G. (2012). Maintenance Medication for Opiate Addiction: The Foundation of Recovery. *Journal of Addictive Diseases*, *31*(3), 207–225. <https://doi.org/10.1080/10550887.2012.694598>.Maintenance
- Bartel, S. J., Sherry, S. B., Mahu, I. T., & Stewart, S. H. (2022). Development of brief cannabis and alcohol motives measures: Psychometric evaluation using expert feedback and longitudinal methods. *Cannabis*.
- Bartel, S. J., Sherry, S. B., Smith, M. M., Vidovic, V. V., & Stewart, S. H. (2018). Is anxiety sensitivity a risk factor for, or complication of, alcohol misuse? A meta-analysis. *Personality and Individual Differences*, *135*, 258–263. <https://doi.org/10.1016/j.paid.2018.07.031>
- Barth, K. S., Maria, M. M.-S. 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*. *22*(5), 486–491. <http://doi.wiley.com/10.1111/j.1521-0391.2013.12038.x>
- Baryshnikov, I., Rosenström, T., Jylhä, P., Koivisto, M., Mantere, O., Suominen, K., Melartin, T., Vuorilehto, M., Holma, M., Riihimäki, K., & Isometsä, E. T. (2018). State and trait hopelessness in a prospective five-year study of patients with depressive disorders. *Journal of Affective Disorders*, *239*, 107–114. <https://doi.org/10.1016/J.JAD.2018.07.007>
- Battista, S. R., Pencer, A., McGonnell, M., Durdle, H., & Stewart, S. H. (2013). Relations of Personality to Substance Use Problems and Mental Health Disorder Symptoms in Two Clinical Samples of Adolescents. *International Journal of Mental Health and Addiction*. <https://doi.org/10.1007/s11469-012-9395-0>
- Battista, S. R., Stewart, S. H., Fulton, H. G., Steeves, D., Darredeau, C., & Gavric, D. (2008). A further investigation of the relations of anxiety sensitivity to smoking motives. *Addictive Behaviors*, *33*(11), 1402–1408. <https://doi.org/10.1016/j.addbeh.2008.06.016>
- Baumeister, M., Vogel, M., Dürsteler-MacFarland, K. M., Gerhard, U., Strasser, J., Walter, M., Wiesbeck, G. A., & Petitjean, S. A. (2014). Association between methadone dose and concomitant cocaine use in methadone maintenance treatment: A register-based study. *Substance Abuse: Treatment, Prevention, and Policy*, *9*(1), 1–8. <https://doi.org/10.1186/1747-597X-9-46>

- Bawor, M., Dennis, B. B., Varenbut, M., Daiter, J., Marsh, D. C., Plater, C., Worster, A., Steiner, M., Anglin, R., Pare, G., Desai, D., Thabane, L., & Samaan, Z. (2015). Sex differences in substance use, health, and social functioning among opioid users receiving methadone treatment: A multicenter cohort study. *Biology of Sex Differences*, 6(1), 1–11. <https://doi.org/10.1186/s13293-015-0038-6>
- Baxley, C., Weinstock, J., Lustman, P. J., & Garner, A. A. (2019). The influence of anxiety sensitivity on opioid use disorder treatment outcomes. *Experimental and Clinical Psychopharmacology*, 27(1), 64–77. <https://doi.org/10.1037/pha0000215>
- Beck, A. T., Brown, G., Steer, R. A., Eidelson, J. I., & Riskind, J. H. (1987). Differentiating Anxiety and Depression: A Test of the Cognitive Content-Specificity Hypothesis. *Journal of Abnormal Psychology*, 96(3), 179–183. <https://doi.org/10.1037/0021-843X.96.3.179>
- Beck, A. T., Steer, R. A., & Brown, G. (1996). Beck Depression Inventory–II (BDI-II) [Database record]. *APA PsychTests*. <https://doi.org/https://doi.org/10.1037/t00742-000>
- Beck, A. T., Ward, C. H., Mendelson, M., Mock, J., & Erbaugh, J. (1961). An Inventory for Measuring Depression. *Archives of General Psychiatry*, 4(6), 561–571. <https://doi.org/10.1001/ARCHPSYC.1961.01710120031004>
- Beck, A. T., Weissman, A., Lester, D., & Trexler, L. (1974). The measurement of pessimism: The Hopelessness Scale. *Journal of Consulting and Clinical Psychology*, 42(6), 861–865. <https://doi.org/10.1037/H0037562>
- Benschop, A., Urbán, R., Kapitány-Fövényi, M., Van Hout, M. C., Dąbrowska, K., Felvinczi, K., Hearne, E., Henriques, S., Kaló, Z., Kamphausen, G., Silva, J. P., Wiczorek, Ł., Werse, B., Bujalski, M., Korf, D., & Demetrovics, Z. (2020). Why do people use new psychoactive substances? Development of a new measurement tool in six European countries. *Journal of Psychopharmacology*, 34(6), 600–611. <https://doi.org/10.1177/0269881120904951>
- Bergamaschi, M. M., Queiroz, R. H. C., Chagas, M. H. N., de Oliveira, D. C. G., De Martinis, B. S., Kapczinski, F., Quevedo, J., Roesler, R., Schröder, N., Nardi, A. E., Martín-Santos, R., Hallak, J. E. C., Zuardi, A. W., & Crippa, J. A. S. (2011). Cannabidiol Reduces the Anxiety Induced by Simulated Public Speaking in Treatment-Naïve Social Phobia Patients. *Neuropsychopharmacology*, 36(6), 1219–1226. <https://doi.org/10.1038/npp.2011.6>
- Biolcati, R., & Passini, S. (2019). Development of the Substance Use Motives Measure (SUMM): A comprehensive eight-factor model for alcohol/drugs consumption. *Addictive Behaviors Reports*, 10, 100199. <https://www.sciencedirect.com/science/article/pii/S2352853219300963>
- Blanchard, B. E., Stevens, A. K., Sher, K. J., & Littlefield, A. K. (2020). Reexamining the Psychometric Properties of the Substance Use Risk Profile Scale. *Assessment*, 27(3), 454–471. <https://doi.org/10.1177/1073191118820135>

- Blessing, E. M., Steenkamp, M. M., Manzanares, J., & Marmar, C. R. (2015). Cannabidiol as a Potential Treatment for Anxiety Disorders. *Neurotherapeutics*, *12*(4), 825. <https://doi.org/10.1007/S13311-015-0387-1>
- Blevins, C. E., Abrantes, A. M., & Stephens, R. S. (2018). The relationship between situational determinants of use and drinking motives. *Addiction Research & Theory*, *26*(1), 28–34. <https://doi.org/10.1080/16066359.2017.1309033>
- 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. *Addictions Research & 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>
- Bond, A., & Lader, M. (2012). Anxiolytics and Sedatives. In J. C. Verster, K. Brady, M. Galanter, & P. J. Conrod (Eds.), *Drug Abuse and Addiction in Medical Illness: Causes, Consequences and Treatment*. Springer Science and Business Media.
- Bonhomme, J., Shim, R. S., Gooden, R., Tyus, D., & Rust, G. (2012). Opioid Addiction and Abuse in Primary Care Practice: A Comparison of Methadone and Buprenorphine as Treatment Options. *Journal of the National Medical Association*, *104*(0), 342. [https://doi.org/10.1016/S0027-9684\(15\)30175-9](https://doi.org/10.1016/S0027-9684(15)30175-9)
- Bonnet, U., & Preuss, U. W. (2017). The cannabis withdrawal syndrome: current insights. *Substance Abuse and Rehabilitation*, *8*, 9. <https://doi.org/10.2147/SAR.S109576>
- Borges, G., Benjet, C., Orozco, R., & Medina-Mora, M. E. (2021). Traumatic life-events and alcohol and drug use disorders among Mexican adolescents: Bidirectional associations over 8 years. *Drug and Alcohol Dependence*, *228*, 109051. <https://doi.org/10.1016/J.DRUGALCDEP.2021.109051>
- Brands, B., Blake, J., Marsh, D. C., Sproule, B., Jeyapalan, R., & Li, S. (2008). The impact of benzodiazepine use on methadone maintenance treatment outcomes. *Journal of Addictive Diseases*, *27*(3), 37–48. <https://doi.org/10.1080/10550880802122620>
- Braun, V., & Clarke, V. (2006). Using thematic analysis in psychology. *Qualitative Research in Psychology*, *3*(2), 77–101. <https://doi.org/10.1191/1478088706qp063oa>
- Bresin, K., & Mekawi, Y. (2019). Do marijuana use motives matter? Meta-analytic associations with marijuana use frequency and problems. *Addictive Behaviors*, *99*, 106102. <https://doi.org/10.1016/j.addbeh.2019.106102>

- Breslin, K., & Mekawi, Y. (2021). The “Why” of Drinking Matters: A Meta-Analysis of the Association Between Drinking Motives and Drinking Outcomes. *Alcoholism, Clinical and Experimental Research*, *45*(1), 38–50. <https://doi.org/10.1111/ACER.14518>
- 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. *Behaviour Research and Therapy*, *38*(12), 1211–1220. [https://doi.org/10.1016/S0005-7967\(99\)00152-7](https://doi.org/10.1016/S0005-7967(99)00152-7)
- Brown, J., Babor, T. F., Litt, M. D., & Kranzler, H. R. (1994). The Type A/Type B distinction: Subtyping alcoholics according to indicators of vulnerability and severity. In *Types of alcoholics: Evidence from clinical, experimental, and genetic research*. (pp. 23–33). New York Academy of Sciences.
- Bruneau, J., Ahamad, K., Goyer, M. È., Poulin, G., Selby, P., Fischer, B., Wild, T. C., & Wood, E. (2018). Management of opioid use disorders: A national clinical practice guideline. *CMAJ*, *190*(9), E247–E257. <https://doi.org/10.1503/cmaj.170958>
- Bruneau, J., Roy, È., Arruda, N., Zang, G., & Jutras-Aswad, D. (2012). The rising prevalence of prescription opioid injection and its association with hepatitis C incidence among street-drug users. *Addiction (Abingdon, England)*, *107*(7), 1318–1327. <https://doi.org/10.1111/J.1360-0443.2012.03803.X>
- Brunelle, C., Assaad, J.-M. M., Barrett, S. P., Ávila, C., Conrod, P. J., Tremblay, R. E., & Pihl, R. O. (2004). Heightened Heart Rate Response to Alcohol Intoxication Is Associated with a Reward-Seeking Personality Profile. *Alcoholism: Clinical and Experimental Research*, *28*(3), 394–401. <https://doi.org/10.1097/01.ALC.0000117859.23567.2E>
- Brunelle, C., & Pihl, R. O. (2007). Effects of Conditioned Reward and Nonreward Cues on the Heart Rate Response to Alcohol Intoxication in Male Social Drinkers. *Alcoholism: Clinical and Experimental Research*, *31*(3), 383–389. <https://doi.org/10.1111/j.1530-0277.2006.00318.x>
- Bürkner, P. C. (2017). brms: An R package for Bayesian multilevel models using Stan. *Journal of Statistical Software*, *80*(1). <https://doi.org/10.18637/jss.v080.i01>
- Bürkner, P. C. (2018). Advanced Bayesian multilevel modeling with the R package brms. *R Journal*, *10*(1), 395–411. <https://doi.org/10.32614/rj-2018-017>
- Busse, J. W., Craigie, S., Juurlink, D. N., Buckley, D. N., Li, W., Couban, R. J., Agoritsas, T., Akl, E. A., Carrasco-Labra, A., Cooper, L., Cull, C., Da Costa, B. R., Frank, J. W., Grant, G., Iorio, A., Persaud, N., Stern, S., Tugwell, P., Vandvik, P. O., & Guyatt, G. H. (2017). Guideline for opioid therapy and chronic noncancer pain. *CMAJ*, *189*(18), E659–E666. <https://doi.org/10.1503/CMAJ.170363/-/DC1>

- Canadian Centre on Substance Use and Addiction. (2017). *Canadian Drug Summary Prescription Opioids*. <http://www.ccsa.ca/Resource Library/CCSA-Canadian-Drug-Summary-Prescription-Opioids-2017-en.pdf>
- Canadian Substance Use Costs and Harms Scientific Working Group. (2018). *Canadian substance use costs and harms (2007–2014)*. (Prepared by the Canadian Institute for Substance Use Research and the Canadian Centre on Substance Use and Addiction.). <http://www.ccsa.ca/Resource Library/CSUCH-Canadian-Substance-Use-Costs-Harms-Report-in-short-2018-en.pdf>
- Canfield, M., Gilvarry, C., & Koller, S. H. (2015). Psychometric Properties of the Substance Use Risk Profile Scale - Brazilian Version. *International Journal of Mental Health and Addiction*, 13(2), 204–214. <https://doi.org/10.1007/s11469-014-9522-1>
- Cappell, H., & Greeley, J. (1987). Alcohol and tension reduction: An update on research and theory. In K. E. Leonard & H. T. Blane (Eds.), *Psychological theories of drinking and alcoholism* (pp. 15–54). Guilford Press.
- Carragher, N., Krueger, R. F., Eaton, N. R., & Slade, T. (2015). Disorders without borders: current and future directions in the meta-structure of mental disorders. *Social Psychiatry and Psychiatric Epidemiology* 2015 50:3, 50(3), 339–350. <https://doi.org/10.1007/S00127-014-1004-Z>
- Carroll, K. M. (2021). The Profound Heterogeneity of Substance Use Disorders: Implications for Treatment Development: <https://doi.org/10.1177/09637214211026984>, 30(4), 358–364. <https://doi.org/10.1177/09637214211026984>
- Castellanos-Ryan, N., & Conrod, P. J. (2012). Personality and Substance Misuse: Evidence for a Four-Factor Model of Vulnerability. In *Drug Abuse and Addiction in Medical Illness* (pp. 47–62). Springer New York. https://doi.org/10.1007/978-1-4614-3375-0_4
- Castellanos-Ryan, N., O’Leary-Barrett, M., Sully, L., & Conrod, P. J. (2013). Sensitivity and Specificity of a Brief Personality Screening Instrument in Predicting Future Substance Use, Emotional, and Behavioral Problems: 18-Month Predictive Validity of the Substance Use Risk Profile Scale. *Alcoholism: Clinical and Experimental Research*, 37(SUPPL.1), 1–10. <https://doi.org/10.1111/j.1530-0277.2012.01931.x>
- Castellanos-Ryan, N., Rubia, K., & Conrod, P. J. (2011). Response Inhibition and Reward Response Bias Mediate the Predictive Relationships Between Impulsivity and Sensation Seeking and Common and Unique Variance in Conduct Disorder and Substance Misuse. *Alcoholism: Clinical and Experimental Research*, 35(1), 140–155. <https://doi.org/10.1111/j.1530-0277.2010.01331.x>

- Castonguay-Jolin, L., Perrier-Ménard, E., Castellanos-Ryan, N., Parent, S., Vitaro, F., Tremblay, R. E., Garel, P., Séguin, J. R., & Conrod, P. J. (2013). Validation de la traduction française de la SURPS pour une population d'adolescents québécois. *The Canadian Journal of Psychiatry, 58*(9), 538–545. <https://doi.org/10.1177/070674371305800909>
- Centers for Disease Control and Prevention (CDC). (2017). *Drug Overdose Death Data*. CDC. <https://www.cdc.gov/drugoverdose/data/statedeaths.html>
- Chandrika Ismail, A., De Alwis Seneviratne, R., Newcombe, P. A., & Wanigaratne, S. (2009). A model of substance abuse risk: Adapting to the Sri Lankan context. *Evaluation Review, 33*(1), 83–97. <https://doi.org/10.1177/0193841X08325145>
- Chen, F., Yang, H., Bulut, O., Cui, Y., & Xin, T. (2019). Examining the relation of personality factors to substance use disorder by explanatory item response modeling of DSM-5 symptoms. *PLOS ONE, 14*(6), e0217630. <https://doi.org/10.1371/journal.pone.0217630>
- Chen, K. W., Berger, C. C., Forde, D. P., D'Adamo, C., Weintraub, E., & Gandhi, D. (2011). Benzodiazepine use and misuse among patients in a methadone program. *BMC Psychiatry, 11*, 90. <https://doi.org/10.1186/1471-244X-11-90>
- Chinneck, A., Thompson, K., Mahu, I. T. T., Davis-MacNevin, P., Dobson, K., & Stewart, S. H. H. (2018). Personality and prescription drug use/misuse among first year undergraduates. *Addictive Behaviors, 87*(June), 122–130. <https://doi.org/10.1016/j.addbeh.2018.07.001>
- Ciccarone, D. (2011). Stimulant Abuse: Pharmacology, Cocaine, Methamphetamine, Treatment, Attempts at Pharmacotherapy. *Primary Care, 38*(1), 41. <https://doi.org/10.1016/J.POP.2010.11.004>
- Ciccocioppo, R., Panocka, I., Frolidi, 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>
- Cicero, T. J., & Ellis, M. S. (2017). The prescription opioid epidemic: a review of qualitative studies on the progression from initial use to abuse. *Dialogues in Clinical Neuroscience, 19*(3), 259. <https://doi.org/10.31887/DCNS.2017.19.3/TCICERO>
- Cicero, T. J., Ellis, M. S., & Kasper, Z. A. (2017). Increased use of heroin as an initiating opioid of abuse. *Addictive Behaviors, 74*, 63–66. <https://doi.org/10.1016/j.addbeh.2017.05.030>
- 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>
- Cloninger, C. R. (1987a). A Systematic Method for Clinical Description and Classification of Personality Variants: A Proposal. *Archives of General Psychiatry, 44*(6), 573–588. <https://doi.org/10.1001/archpsyc.1987.01800180093014>

- Cloninger, C. R. (1987b). Neurogenetic adaptive mechanisms in alcoholism. *Science*, 236(4800), 410–416. <https://doi.org/10.1126/science.2882604>
- Comeau, N., Stewart, S. H., & Loba, P. (2001). The relations of trait anxiety, anxiety sensitivity, and sensation seeking to adolescents' motivations for alcohol, cigarette, and marijuana use. *Addictive Behaviors*, 26(6), 803–825. [https://doi.org/https://doi.org/10.1016/S0306-4603\(01\)00238-6](https://doi.org/https://doi.org/10.1016/S0306-4603(01)00238-6)
- Comer, S., Cunningham, C., Fishman, M. J., Gordon, A., Kampman, K., Langleben, D., Nordstrom, B., Oslin, D., Woody, G., Wright, T., Wyatt, S., Femino, J., Jarvis, M., Kotz, M., Pirard, S., Roose, R. J., Geier-Horan, A., Staff, A., Haynes, B., ... Woodworth, A. (2015). *National Practice Guideline for the Use of Medications in the Treatment of Addiction Involving Opioid Use ASAM National Practice Guideline for the Use of Medi-cations in the Treatment of Addiction Involving Opioid Use*. <https://www.asam.org/docs/default-source/practice-support/guidelines-and-consensus-docs/asam-national-practice-guideline-supplement.pdf?sfvrsn=24>
- Compton, W. M., Han, B., Blanco, C., Johnson, K., & Jones, C. M. (2018). *Prevalence and Correlates of Prescription Stimulant Use, Misuse, Use Disorders, and Motivations for Misuse Among Adults in the United States*. 175(8), 741–755. <http://ajp.psychiatryonline.org/doi/10.1176/appi.ajp.2018.17091048>
- Compton, W. M., Jones, C. M., & Baldwin, G. T. (2016). Relationship between Nonmedical Prescription-Opioid Use and Heroin Use. *New England Journal of Medicine*, 374(2), 154–163. <https://doi.org/10.1056/NEJMra1508490>
- Compton, W. M., Valentino, R. J., & DuPont, R. L. (2021). Polysubstance use in the U.S. opioid crisis. In *Molecular Psychiatry* (Vol. 26, Issue 1, pp. 41–50). Springer Nature. <https://doi.org/10.1038/s41380-020-00949-3>
- Compton, W. M., & Volkow, N. D. (2006). Abuse of prescription drugs and the risk of addiction. *Drug and Alcohol Dependence*, 83, S4–S7. <https://doi.org/10.1016/J.DRUGALCDEP.2005.10.020>
- Connock, M., Juarez-Garcia, A., Jowett, S., Frew, E., Liu, Z., Taylor, R., Fry-Smith, A., Day, E., Lintzeris, N., Roberts, T., Burls, A., & Taylor, R. (2007). Methadone and buprenorphine for the management of opioid dependence: a systematic review and economic evaluation. *Health Technology Assessment*, 11(9). <https://www.ncbi.nlm.nih.gov/books/NBK62286/>
- Connor, J. P., Gullo, M. J., White, A., & Kelly, A. B. (2014). Polysubstance use: diagnostic challenges, patterns of use and health. *Current Opinion in Psychiatry*, 27(4), 269–275. <https://doi.org/10.1097/YCO.0000000000000069>
- Conrod, P. J. (2016). Personality-Targeted Interventions for Substance Use and Misuse. *Current Addiction Reports*, 3(4), 426–436. <https://doi.org/10.1007/s40429-016-0127-6>

- Conrod, P. J., Castellanos-Ryan, N., & MacKie, C. (2011). Long-term effects of a personality-targeted intervention to reduce alcohol use in adolescents. *Journal of Consulting and Clinical Psychology, 79*(3), 296–306. <https://doi.org/10.1037/a0022997>
- Conrod, P. J., Castellanos, N., & Mackie, C. (2008). Personality-targeted interventions delay the growth of adolescent drinking and binge drinking. *Journal of Child Psychology and Psychiatry and Allied Disciplines, 49*(2), 181–190. <https://doi.org/10.1111/j.1469-7610.2007.01826.x>
- Conrod, P. J., & Nikolaou, K. (2016). Annual Research Review: On the developmental neuropsychology of substance use disorders. *Journal of Child Psychology and Psychiatry, 57*(3), 371–394. <https://doi.org/10.1111/jcpp.12516>
- Conrod, P. J., O’Leary-Barrett, M., Newton, N., Topper, L., Castellanos-Ryan, N., MacKie, C., & Girard, A. (2013). Effectiveness of a selective, personality-targeted prevention program for adolescent alcohol use and misuse: A cluster randomized controlled trial. *JAMA Psychiatry, 70*(3), 334–342. <https://doi.org/10.1001/jamapsychiatry.2013.651>
- Conrod, P. J., Pihl, R. O., Stewart, S. H., & Dongier, M. (2000). Validation of a system of classifying female substance abusers on the basis of personality and motivational risk factors for substance abuse. *Psychology of Addictive Behaviors, 14*(3), 243–256. <https://doi.org/10.1037/0893-164X.14.3.243>
- Conrod, P. J., Pihl, R., & Vassileva, J. (1998). Differential sensitivity to alcohol reinforcement in groups of men at risk for distinct alcoholism subtypes. *Alcoholism: Clinical and Experimental Research, 22*(3), 585–597. <https://doi.org/10.1111/j.1530-0277.1998.tb04297.x>
- Conrod, P. J., Stewart, S. H., Comeau, N., & Maclean, A. M. (2006). Efficacy of cognitive-behavioral interventions targeting personality risk factors for youth alcohol misuse. *Journal of Clinical Child and Adolescent Psychology, 35*(4), 550–563. https://doi.org/10.1207/s15374424jccp3504_6
- Conrod, P. J., Stewart, S. H., Pihl, R. O., Cote, S., Fontaine, V., & Dongier, M. (2000). Efficacy of brief coping skills interventions that match different personality profiles of female substance abusers. *Psychology of Addictive Behaviors, 14*(3), 231–242. <https://doi.org/10.1037/0893-164X.14.3.231>
- Conway, K. P., Compton, W., Stinson, F. S., & Grant, B. F. (2006). Lifetime comorbidity of DSM-IV mood and anxiety disorders and specific drug use disorders: Results from the National Epidemiologic Survey on Alcohol and Related Conditions. *Journal of Clinical Psychiatry, 67*(2), 247–257.
- Conway, K. P., Levy, J., Vanyukov, M., Chandler, R., Rutter, J., Swan, G. E., & Neale, M. (2010). Measuring Addiction Propensity and Severity: The Need for a New Instrument. *Drug and Alcohol Dependence, 111*(1–2), 4. <https://doi.org/10.1016/J.DRUGALCDEP.2010.03.011>

- Cooper, M. L. (1994). Motivations for alcohol use among adolescents: Development and validation of a four-factor model. *Psychological Assessment, 6*(2), 117–128. <https://doi.org/10.1037/1040-3590.6.2.117>
- Cooper, M. L., Frone, M. R., Russell, M., & Mudar, P. (1995). Drinking to Regulate Positive and Negative Emotions: A Motivational Model of Alcohol Use. *Journal of Personality and Social Psychology, 69*(5), 990–1005. <https://doi.org/10.1037/0022-3514.69.5.990>
- 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. Sher (Ed.), *The Oxford handbook of substance use and substance use disorders*. (1st ed., Vol. 1, pp. 1–656). Oxford University Press. <https://doi.org/10.1093/oxfordhb/9780199381678.013.017>
- Cornwall, A., & Jewkes, R. (1995). What is participatory research? *Social Science & Medicine, 41*(12), 1667–1676. [https://doi.org/10.1016/0277-9536\(95\)00127-S](https://doi.org/10.1016/0277-9536(95)00127-S)
- Corruble, E., Benyamina, A., Bayle, F., Falissard, B., & Hardy, P. (2003). Understanding impulsivity in severe depression? A psychometrical contribution. *Progress in Neuro-Psychopharmacology and Biological Psychiatry, 27*(5), 829–833. [https://doi.org/10.1016/S0278-5846\(03\)00115-5](https://doi.org/10.1016/S0278-5846(03)00115-5)
- Costa, P. T., & McCrae, R. R. (1992). *Revised NEO Personality Inventory (NEO-PI-R) and NEO Five-Factor Inventory (NEO-FFI) professional manual*. Psychological Assessment Resources.
- Cottler, L. B., Compton, W. M., Mager, D., Spitznagel, E. L., & Janca, A. (1992). Posttraumatic stress disorder among substance users from the general population. *American Journal of Psychiatry, 149*(5), 664–670. <https://doi.org/10.1176/ajp.149.5.664>
- Cox, W. M., & Klinger, E. (1988). A motivational model of alcohol use. *Journal of Abnormal Psychology, 97*(2), 168–180. <https://doi.org/10.1037//0021-843x.97.2.168>
- Crane, N. A., Schuster, R. M., Fusar-Poli, P., & Gonzalez, R. (2013). Effects of cannabis on neurocognitive functioning: Recent advances, neurodevelopmental influences, and sex differences. *Neuropsychology Review, 23*(2), 117–137. <https://doi.org/10.1007/s11065-012-9222-1>
- Crean, R. D., Tapert, S. F., Minassian, A., MacDonald, K., Crane, N. A., & Mason, B. J. (2011). Effects of chronic, heavy cannabis use on executive functions. *Journal of Addiction Medicine, 5*(1), 9–15. <https://doi.org/10.1097/ADM.0b013e31820cdd57>
- Crews, F. T., & Boettiger, C. A. (2009). Impulsivity, frontal lobes and risk for addiction. *Pharmacology Biochemistry and Behavior, 93*(3), 237–247. <https://doi.org/10.1016/j.pbb.2009.04.018>
- Crummy, E. A., O’Neal, T. J., Baskin, B. M., & Ferguson, S. M. (2020). One Is Not Enough: Understanding and Modeling Polysubstance Use. *Frontiers in Neuroscience, 14*(569). <https://doi.org/10.3389/fnins.2020.00569>

- Darke, S. (1998). Self-report among injecting drug users: A review. *Drug and Alcohol Dependence*, *51*(3), 253–263. [https://doi.org/10.1016/S0376-8716\(98\)00028-3](https://doi.org/10.1016/S0376-8716(98)00028-3)
- Darke, S. (2011). The Life of the Heroin User: Typical beginnings, trajectories and outcomes. In *The Life of the Heroin User: Typical Beginnings, Trajectories and Outcomes*. Cambridge University Press. <https://doi.org/10.1017/CBO9780511732249>
- Darke, S., & Ross, J. (1997). Polydrug dependence and psychiatric comorbidity among heroin injectors. *Drug and Alcohol Dependence*, *48*(2), 135–141. [https://doi.org/10.1016/S0376-8716\(97\)00117-8](https://doi.org/10.1016/S0376-8716(97)00117-8)
- Darke, S., Swift, W., Hall, W., & Ross, M. (1993). Drug use, HIV risk-taking and psychosocial correlates of benzodiazepine use among methadone maintenance clients. *Drug and Alcohol Dependence*, *34*(1), 67–70. [https://doi.org/10.1016/0376-8716\(93\)90047-T](https://doi.org/10.1016/0376-8716(93)90047-T)
- Dawe, S., & Loxton, N. J. (2004). The role of impulsivity in the development of substance use and eating disorders. *Neuroscience and Biobehavioral Reviews*, *28*(3), 343–351. <https://doi.org/10.1016/J.NEUBIOREV.2004.03.007>
- Dawson, D. A., Goldstein, R. B., & Grant, B. F. (2007). Rates and correlates of relapse among individuals in remission from DSM-IV alcohol dependence: a 3-year follow-up. *Alcoholism, Clinical and Experimental Research*, *31*(12), 2036–2045. <https://doi.org/10.1111/J.1530-0277.2007.00536.X>
- Dawson, D. A., Grant, B. F., Stinson, F. S., Chou, P. S., Huang, B., & Ruan, W. J. (2005). Recovery from DSM-IV alcohol dependence: United States, 2001-2002. *Addiction (Abingdon, England)*, *100*(3), 281–292. <https://doi.org/10.1111/J.1360-0443.2004.00964.X>
- Degenhardt, L., Hall, W., & Warner-Smith, M. (2006). Using cohort studies to estimate mortality among injecting drug users that is not attributable to AIDS. *Sexually Transmitted Infections*, *82*(SUPPL. III), 56–63. <https://doi.org/10.1136/sti.2005.019273>
- Degenhardt, L., Whiteford, H. A., Ferrari, A. J., Baxter, A. J., Charlson, F. J., Hall, W. D., Freedman, G., Burstein, R., Johns, N., Engell, R. E., Flaxman, A., Murray, C. J. L., & Vos, T. (2013). Global burden of disease attributable to illicit drug use and dependence: Findings from the Global Burden of Disease Study 2010. *The Lancet*, *382*(9904), 1564–1574. [https://doi.org/10.1016/S0140-6736\(13\)61530-5](https://doi.org/10.1016/S0140-6736(13)61530-5)
- DeMaria, P. A., Sterling, R., & Weinstein, S. P. (2000). The effect of stimulant and sedative use on treatment outcome of patients admitted to methadone maintenance treatment. *The American Journal on Addictions*, *9*(2), 145–153. <https://doi.org/10.1080/10550490050173217>
- Demers, A., Kairouz, S., Adlaf, E., Gliksman, L., Newton-Taylor, B., & Marchand, A. (2002). Multilevel analysis of situational drinking among Canadian undergraduates. *Social Science and Medicine*, *55*(3), 415–424. [https://doi.org/10.1016/S0277-9536\(01\)00258-1](https://doi.org/10.1016/S0277-9536(01)00258-1)

- Denis, C., Fatséas, M., Beltran, V., Bonnet, C., Picard, S., Combourieu, I., Dauloude, J. P., & Auriacombe, M. (2012). Validity of the self-reported drug use section of the Addiction Severity Index and associated factors used under naturalistic conditions. *Substance Use & Misuse*, *47*(4), 356–363. <https://doi.org/10.3109/10826084.2011.640732>
- Dennis, B. B., Bawor, M., Naji, L., Chan, C. K., Varenbut, J., Paul, J., Varenbut, M., Daiter, J., Plater, C., Pare, G., Marsh, D. C., Worster, A., Desai, D., Thabane, L., & Samaan, Z. (2015). Impact of chronic pain on treatment prognosis for patients with opioid use disorder: A systematic review and meta-analysis. *Substance Abuse: Research and Treatment*, *9*, 59–80. <https://doi.org/10.4137/SART.S30120>
- Do, H. P., Nguyen, L. H., Thi Nguyen, N. P., Ngo, C., Thi Nguyen, H. L., Le, G. T., Nguyen, L. K., Nguyen, C. T., Tran, B. X., Le, H. T., Vu, T. M. T., Phan, H. T. T., Tran, T. D., Latkin, C. A., & Dunne, M. P. (2017). Factors associated with nicotine dependence during methadone maintenance treatment: Findings from a multisite survey in Vietnam. In *BMJ Open* (Vol. 7, Issue 7). BMJ Publishing Group. <https://doi.org/10.1136/bmjopen-2017-015889>
- Docherty, J. R., & Alsufyani, H. A. (2021). Pharmacology of Drugs Used as Stimulants. *The Journal of Clinical Pharmacology*, *61*(S2), S53–S69. <https://doi.org/10.1002/JCPH.1918>
- Donny, E. C., Brassler, S. M., Bigelow, G. E., Stitzer, M. L., & Walsh, S. L. (2005). Methadone doses of 100 mg or greater are more effective than lower doses at suppressing heroin self-administration in opioid-dependent volunteers. *Addiction*, *100*(10), 1496–1509. <https://doi.org/10.1111/j.1360-0443.2005.01232.x>
- Donny, E. C., Walsh, S. L., Bigelow, G. E., Eissenberg, T., & Stitzer, M. L. (2002). High-dose methadone produces superior opioid blockade and comparable withdrawal suppression to lower doses in opioid-dependent humans. *Psychopharmacology*, *161*(2), 202–212. <https://doi.org/10.1007/s00213-002-1027-0>
- Dowell, D., Haegerich, T. M., & Chou, R. (2016). CDC Guideline for Prescribing Opioids for Chronic Pain—United States, 2016. *JAMA*, *315*(15), 1624. <https://doi.org/10.1001/jama.2016.1464>
- Dugosh, K., Abraham, A., Seymour, B., McLoyd, K., Chalk, M., & Festinger, D. (2016). A Systematic Review on the Use of Psychosocial Interventions in Conjunction With Medications for the Treatment of Opioid Addiction. *Journal of Addiction Medicine*, *10*(2), 93–103. <https://doi.org/10.1097/ADM.0000000000000193>
- Dunlap, B., & Cifu, A. S. (2016). Clinical Management of Opioid Use Disorder. *JAMA*, *316*(3), 338–339. <https://doi.org/10.1001/JAMA.2016.9795>
- Durbin, C. E., & Hicks, B. M. (2014). Personality and psychopathology: A stagnant field in need of development. *European Journal of Personality*, *28*(4), 362–386. <https://doi.org/10.1002/PER.1962/FULL>

- Dvorak, R. D., Stevenson, B. L., Kilwein, T. M., Sargent, E. M., Dunn, M. E., Leary, A. V., & Kramer, M. P. (2018). Tension Reduction and Affect Regulation: An Examination of Mood Indices on Drinking and Non-Drinking Days among University Student Drinkers. *Experimental and Clinical Psychopharmacology*, 26(4), 377. <https://doi.org/10.1037/PHA0000210>
- Dworkin, E. R. (2020). Risk for Mental Disorders Associated With Sexual Assault: A Meta-Analysis. *Trauma, Violence, and Abuse*, 21(5), 1011–1028. <https://doi.org/10.1177/1524838018813198>
- Eaton, N. R., Rodriguez-Seijas, C., Carragher, N., & Krueger, R. F. (2015). Transdiagnostic factors of psychopathology and substance use disorders: a review. *Social Psychiatry and Psychiatric Epidemiology* 2015 50:2, 50(2), 171–182. <https://doi.org/10.1007/S00127-014-1001-2>
- Edalati, H., & Conrod, P. J. (2019). A Review of Personality-Targeted Interventions for Prevention of Substance Misuse and Related Harm in Community Samples of Adolescents. *Frontiers in Psychiatry*, 9, 770. <https://doi.org/10.3389/fpsy.2018.00770>
- Eibl, J. K., Morin, K., Leinonen, E., & Marsh, D. C. (2017). The State of Opioid Agonist Therapy in Canada 20 Years after Federal Oversight. *Canadian Journal of Psychiatry. Revue Canadienne de Psychiatrie*, 62(7), 444–450. <https://doi.org/10.1177/0706743717711167>
- El-Bassel, N., Shaw, S. A., Dasgupta, A., & Strathdee, S. A. (2014). Drug use as a driver of HIV Risks: Re-emerging and emerging issues. *Current Opinion in HIV and AIDS*, 9(2), 150. <https://doi.org/10.1097/COH.0000000000000035>
- Elo, S., & Kyngäs, H. (2008). The qualitative content analysis process. *Journal of Advanced Nursing*, 62(1), 107–115. <https://doi.org/10.1111/J.1365-2648.2007.04569.X>
- Epstein, D. H., & Preston, K. L. (2003). Does cannabis use predict poor outcome for heroin-dependent patients on maintenance treatment? Past findings and more evidence against. *Addiction (Abingdon, England)*, 98(3), 269–279. <https://doi.org/10.1046/J.1360-0443.2003.00310.X>
- Ersche, K. D., Turton, A. J., Pradhan, S., Bullmore, E. T., & Robbins, T. W. (2010). Drug addiction endophenotypes: Impulsive versus sensation-seeking personality traits. *Biological Psychiatry*, 68(8), 770–773. <https://doi.org/10.1016/j.biopsych.2010.06.015>
- Everson, S. A., Goldberg, D. E., Kaplan, G. A., Cohen, R. D., Pukkala, E., Tuomilehto, J., & Salonen, J. T. (1996). Hopelessness and Risk of Mortality and Incidence of Myocardial Infarction and Cancer. *Psychosomatic Medicine*, 58(2), 113–121. <https://doi.org/10.1097/00006842-199603000-00003>

- Eysenck, H. J. (1979). Crime and personality. *Medico-Legal Journal*, 47(1), 18–32. <https://doi.org/10.1177/002581727904700104>
- Eysenck, H. J. (1997). Addiction, Personality and Motivation. *Ltd. Hum. Psychopharmacol. Clin. Exp*, 12, 79–87.
- Eysenck, S. B., & Eysenck, H. J. (1978). Impulsiveness and venturesomeness: their position in a dimensional system of personality description. *Psychological Reports*, 43(3 Pt 2), 1247–1255. <https://doi.org/10.2466/pr0.1978.43.3f.1247>
- Faggiano, F., Vigna-Taglianti, F., Versino, E., & Lemma, P. (2003). Methadone maintenance at different dosages for opioid dependence. *Cochrane Database of Systematic Reviews*. <https://doi.org/10.1002/14651858.cd002208>
- Farnum, S., Makarenko, I., Madden, L., Mazhnaya, A., Marcus, R., Prokhorova, T., Bojko, M., Rozanova, J., Dvoriak, S., Islam, Z., & Altice, F. (2021). The real-world impact of dosing of methadone and buprenorphine in retention on opioid agonist therapies in Ukraine. *Addiction (Abingdon, England)*, 116(1), 83–93. <https://doi.org/10.1111/ADD.15115>
- Fatséas, M., Lavie, E., Denis, C., & Auriacombe, M. (2009). Self-perceived motivation for benzodiazepine use and behavior related to benzodiazepine use among opiate-dependent patients. *Journal of Substance Abuse Treatment*, 37(4), 407–411. <https://doi.org/10.1016/j.jsat.2009.03.006>
- Fischer, B., Keates, A., Bühringer, G., Reimer, J., & Rehm, J. (2014). Non-medical use of prescription opioids and prescription opioid-related harms: Why so markedly higher in North America compared to the rest of the world? *Addiction*, 109(2), 177–181. <https://doi.org/10.1111/add.12224>
- Foa, E. B., Riggs, D. S., Dancu, C. V., & Rothbaum, B. O. (1993). Reliability and validity of a brief instrument for assessing post-traumatic stress disorder. *Journal of Traumatic Stress*, 6(4), 459–473. <https://doi.org/10.1002/JTS.2490060405>
- Fontes, M. A., Bolla, K. I., Cunha, P. J., Almeida, P. P., Jungerman, F., Laranjeira, R. R., Bressan, R. A., & Lacerda, A. L. T. (2011). Cannabis use before age 15 and subsequent executive functioning. *British Journal of Psychiatry*, 198(6), 442–447. <https://doi.org/10.1192/bjp.bp.110.077479>
- 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>
- Franken, I. H. A., Muris, P., & Georgieva, I. (2006). Gray's model of personality and addiction. *Addictive Behaviors*, 31(3), 399–403. <https://doi.org/10.1016/J.ADDBEH.2005.05.022>
- Franklyn, A. M., Eibl, J. K., Gauthier, G. J., & Marsh, D. C. (2017). The impact of cannabis use on patients enrolled in opioid agonist therapy in Ontario, Canada. *PloS One*, 12(11). <https://doi.org/10.1371/JOURNAL.PONE.0187633>

- Franklyn, A. M., Eibl, J. K., Gauthier, G. J., Pellegrini, D., Lightfoot, N. E., & Marsh, D. C. (2017a). The impact of cocaine use in patients enrolled in opioid agonist therapy in Ontario, Canada. *International Journal of Drug Policy*, *48*, 1–8. <https://doi.org/10.1016/j.drugpo.2017.05.044>
- Franklyn, A. M., Eibl, J. K., Gauthier, G., Pellegrini, D., Lightfoot, N. K., & Marsh, D. C. (2017b). The impact of benzodiazepine use in patients enrolled in opioid agonist therapy in Northern and rural Ontario. *Harm Reduction Journal*, *14*(1). <https://doi.org/10.1186/s12954-017-0134-5>
- Fulton, H. G., Barrett, S. P., MacIsaac, C., & Stewart, S. H. (2011). The relationship between self-reported substance use and psychiatric symptoms in low-threshold methadone maintenance treatment clients. *Harm Reduction Journal*. <https://doi.org/10.1186/1477-7517-8-18>
- Galarneau, L. R., Hilburt, J., O'Neill, Z. R., Buxton, J. A., Scheuermeyer, F. X., Dong, K., Kaczorowski, J., Orkin, A. M., Barbic, S. P., Bath, M., Moe, J., Miles, I., Tobin, D., Grier, S., Garrod, E., & Kestler, A. (2021). Experiences of people with opioid use disorder during the COVID-19 pandemic: A qualitative study. *PLOS ONE*, *16*(7), e0255396. <https://doi.org/10.1371/JOURNAL.PONE.0255396>
- 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. *Addictive Behaviors*, 106753. <https://doi.org/10.1016/j.addbeh.2020.106753>
- Geoffrion, R., Yang, E. C., Koenig, N. A., Brotto, L. A., Barr, A. M., Lee, T., Allaire, C., Bedaiwy, M. A., & Yong, P. J. (2021). Recreational Cannabis Use Before and After Legalization in Women With Pelvic Pain. *Obstetrics and Gynecology*, *137*(1), 91–99. <https://doi.org/10.1097/AOG.0000000000004207>
- Gjedde, A., Kumakura, Y., Cumming, P., Linnet, J., & Møller, A. (2010). Inverted-U-shaped correlation between dopamine receptor availability in striatum and sensation seeking. *Proceedings of the National Academy of Sciences of the United States of America*, *107*(8), 3870–3875. <https://doi.org/10.1073/pnas.0912319107>
- Glenn, M. C., Sohler, N. L., Starrels, J. L., Maradiaga, J., Jost, J. J., Arnsten, J. H., & Cunningham, C. O. (2016). Characteristics of methadone maintenance treatment patients prescribed opioid analgesics. *Substance Abuse*, *37*(3), 387. <https://doi.org/10.1080/08897077.2015.1135225>
- 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>
- Goldstein, R. Z., & Volkow, N. D. (2002). Drug addiction and its underlying neurobiological basis: neuroimaging evidence for the involvement of the frontal cortex. *The American Journal of Psychiatry*, *159*(10), 1642–1652. <https://doi.org/10.1176/APPI.AJP.159.10.1642>

- Goodman, A. (2008). Neurobiology of addiction. An integrative review. *Biochemical Pharmacology*, 75(1), 266–322. <https://doi.org/10.1016/j.bcp.2007.07.030>
- Goudriaan, A. E., & Sher, K. J. (2012). Alcohol. In J. C. Verster, K. Brady, M. Galanter, & P. J. Conrod (Eds.), *Drug Abuse and Addiction in Medical Illness: Causes, Consequences and Treatment* (pp. 123–135). Springer.
- Gowing, L., Ali, R., Dunlop, A., Farrell, M., & Lintzeris, N. (2014). *National Guidelines for Medication-Assisted Treatment of Opioid Dependence*. <https://www.health.gov.au/sites/default/files/national-guidelines-for-medication-assisted-treatment-of-opioid-dependence.docx>
- Granö, N., Keltikangas-JÄRVINEN, L., Kouvonen, A., Virtanen, M., Elovainio, M., Vahtera, J., & Kivimäki, M. (2007). Impulsivity as a predictor of newly diagnosed depression. *Scandinavian Journal of Psychology*, 48(2), 173–179. <https://doi.org/10.1111/j.1467-9450.2007.00566.x>
- Grant, B. F., Stinson, F. S., Dawson, D. A., Chou, S. P., Dufour, M. C., Compton, W., Pickering, R. P., & Kaplan, K. (2004). Prevalence and co-occurrence of substance use disorders and independent mood and anxiety disorders: Results from the national epidemiologic survey on alcohol and related conditions. *Archives of General Psychiatry*, 61(8), 807–816. <https://doi.org/10.1001/archpsyc.61.8.807>
- 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. *Addictive Behaviors*, 32(11), 2611–2632. <https://doi.org/10.1016/j.addbeh.2007.07.004>
- Gray, J. A. (1970). The psychophysiological basis of introversion-extraversion. *Behaviour Research and Therapy*, 8(3), 249–266. [https://doi.org/10.1016/0005-7967\(70\)90069-0](https://doi.org/10.1016/0005-7967(70)90069-0)
- Gray, J. A. (1982). The neuropsychology of anxiety: An enquiry into the functions of the septo-hippocampal system. In *The neuropsychology of anxiety: An enquiry into the functions of the septo-hippocampal system*. Clarendon Press/Oxford University Press.
- Gray, J. A. (1987). *The psychology of fear and stress* (2nd ed.). Cambridge University Press. <https://books.google.com/books?hl=en&lr=&id=nww5AAAAIAAJ&oi=fnd&pg=PR6&ots=rpws3qWinZ&sig=WRjkFIkObPbvGhcbGCAiDbbMInA>
- Greenfield, L., Brady, J. V., Besteman, K. J., & De Smet, A. (1996). Patient retention in mobile and fixed-site methadone maintenance treatment. *Drug and Alcohol Dependence*, 42(2), 125–131. [https://doi.org/10.1016/0376-8716\(96\)01273-2](https://doi.org/10.1016/0376-8716(96)01273-2)
- Grella, C. E., Anglin, M. D., & Wugalter, S. E. (1995). Cocaine and crack use and HIV risk behaviors among high-risk methadone maintenance clients. *Drug and Alcohol Dependence*, 37(1), 15–21. [https://doi.org/10.1016/0376-8716\(94\)01059-T](https://doi.org/10.1016/0376-8716(94)01059-T)

- Grella, C. E., Anglin, M. D., & Wugalter, S. E. (1997). Patterns and predictors of cocaine and crack use by clients in standard and enhanced methadone maintenance treatment. *The American Journal of Drug and Alcohol Abuse*, 23(1), 15–42. <https://doi.org/10.3109/00952999709001685>
- Gross, S. R., Barrett, S. P., Shestowsky, J. S., & Pihl, R. O. (2002). Ecstasy and drug consumption patterns: A Canadian rave population study. *Canadian Journal of Psychiatry*, 47(6), 546–551. <https://doi.org/10.1177/070674370204700606>
- Gudin, J. A., Mogali, S., Jones, J. D., & Comer, S. D. (2013). Risks, Management, and Monitoring of Combination Opioid, Benzodiazepines, and/or Alcohol Use. *Postgraduate Medicine*, 125(4), 115. <https://doi.org/10.3810/PGM.2013.07.2684>
- Guillot, C. R., Leventhal, A. M., Raines, A. M., Zvolensky, M. J., & Schmidt, N. B. (2016). Anxiety sensitivity facets in relation to tobacco use, abstinence-related problems, and cognitions in treatment-seeking smokers. *Addictive Behaviors*, 56, 30–35. <https://doi.org/10.1016/j.addbeh.2016.01.005>
- Gupta, M., Gokarakonda, S. B., & Attia, F. N. (2021). Withdrawal Syndromes. In *StatPearls*. StatPearls Publishing. <http://www.ncbi.nlm.nih.gov/pubmed/29083712>
- Gustin, S. M., Peck, C. C., Macey, P. M., Murray, G. M., & Henderson, L. A. (2013). Unraveling the Effects of Plasticity and Pain on Personality. *The Journal of Pain*, 14(12), 1642–1652. <https://doi.org/10.1016/J.JPAIN.2013.08.005>
- Hall, S. M. (2009). The Abstinence Phobias: Links between Substance Abuse and Anxiety. <Http://Dx.Doi.Org/10.3109/10826088409057210>, 19(6), 613–631. <https://doi.org/10.3109/10826088409057210>
- Haller, M., & Chassin, L. (2014). Risk Pathways among Traumatic Stress, Posttraumatic Stress Disorder Symptoms, and Alcohol and Drug Problems: A Test of Four Hypotheses. *Psychology of Addictive Behaviors : Journal of the Society of Psychologists in Addictive Behaviors*, 28(3), 841. <https://doi.org/10.1037/A0035878>
- Hammarberg, A., Öster, C., & Nehlin, C. (2017). Drinking motives of adult patients seeking treatment for problematic alcohol use. *Journal of Addictive Diseases*, 36(2), 127–135. <https://doi.org/10.1080/10550887.2017.1291052>
- Haydon, E., Rehm, J., Fischer, B., Monga, N., & Adlaf, E. (2005). Prescription Drug Abuse in Canada and the Diversion of Prescription Drugs into the Illicit Drug Market. *Canadian Journal of Public Health = Revue Canadienne de Santé Publique*, 96(6), 459. <https://doi.org/10.1007/BF03405190>
- Hearon, B. A., Calkins, A. W., Halperin, D. M., Kathryn McHugh, R., Murray, H. W., & Otto, M. W. (2011). Anxiety sensitivity and illicit sedative use among opiate-dependent women and men. *American Journal of Drug and Alcohol Abuse*, 37(1), 43–47. <https://doi.org/10.3109/00952990.2010.535581>
- Hecimovic, K., Barrett, S. P., Darredeau, C., & Stewart, S. H. (2014). Cannabis use motives and personality risk factors. *Addictive Behaviors*, 39(3), 729–732. <https://doi.org/10.1016/j.addbeh.2013.11.025>

- Hilario, E. Y., Griffin, M. L., McHugh, R. K., McDermott, K. A., Connery, H. S., Fitzmaurice, G. M., & Weiss, R. D. (2015). Denial of urinalysis-confirmed opioid use in prescription opioid dependence. *Journal of Substance Abuse Treatment, 48*(1), 85–90. <https://doi.org/10.1016/J.JSAT.2014.07.003>
- Hill, D. R., Conroy, S., Afzal, A., Lang, D., Steele, S., & Campbell, D. (2015). A comparison of methadone and buprenorphine–naloxone as opioid substitution therapy: the patient perspective in NHS Lanarkshire. *Http://Dx.Doi.Org/10.3109/14659891.2014.894589, 20*(3), 168–177. <https://doi.org/10.3109/14659891.2014.894589>
- Hopley, A., & Brunelle, C. (2016). Substance use in incarcerated male offenders: Predictive validity of a personality typology of substance misusers. *Addictive Behaviors, 53*, 86–93. <https://doi.org/10.1016/j.addbeh.2015.10.001>
- Howell, A. N., Leyro, T. M., Hogan, J., Buckner, J. D., & Zvolensky, M. J. (2010). Anxiety sensitivity, distress tolerance, and discomfort intolerance in relation to coping and conformity motives for alcohol use and alcohol use problems among young adult drinkers. *Addictive Behaviors, 35*(12), 1144–1147. <https://doi.org/10.1016/j.addbeh.2010.07.003>
- Hser, Y. I., Evans, E., Grella, C., Ling, W., & Anglin, D. (2015). Long-term course of opioid addiction. *Harvard Review of Psychiatry, 23*(2), 76–89. <https://doi.org/10.1097/HRP.0000000000000052>
- Iguchi, M. Y., Handelsman, L., Bickel, W. K., & Griffiths, R. R. (1993). Benzodiazepine and sedative use/abuse by methadone maintenance clients. *Drug and Alcohol Dependence, 32*(3), 257–266. [https://doi.org/10.1016/0376-8716\(93\)90090-D](https://doi.org/10.1016/0376-8716(93)90090-D)
- Jones, J. D., Mogali, S., & Comer, S. D. (2012). Polydrug abuse: A review of opioid and benzodiazepine combination use. *Drug and Alcohol Dependence, 125*(1–2), 8–18. <https://doi.org/10.1016/j.drugalcdep.2012.07.004>
- 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. *Psychology of Addictive Behaviors, 28*(4), 1290–1296. <https://doi.org/10.1037/a0037783>
- Joseph, H., Stancliff, S., & Langrod, J. (2000). Methadone maintenance treatment (MMT): a review of historical and clinical issues. *The Mount Sinai Journal of Medicine, New York, 67*(5–6), 347–364.
- Joyce, K. M., Hudson, A., O'Connor, R., Thompson, K., Hodgins, M., Perrot, T., & Stewart, S. H. (2018). Changes in coping and social motives for drinking and alcohol consumption across the menstrual cycle. *Depression and Anxiety, 35*(4), 313–320. <https://doi.org/10.1002/da.22699>

- Jurk, S., Kuitunen-Paul, S., Kroemer, N. B., Artiges, E., Banaschewski, T., Bokde, A. L. W. W., Büchel, C., Conrod, P. J., Fauth-Bühler, M., Flor, H., Frouin, V., Gallinat, J., Garavan, H., Heinz, A., Mann, K. F., Nees, F., Paus, T., Pausova, Z., Poustka, L., ... IMAGEN consortium. (2015). Personality and Substance Use: Psychometric Evaluation and Validation of the Substance Use Risk Profile Scale (SURPS) in English, Irish, French, and German Adolescents. *Alcoholism: Clinical and Experimental Research*, 39(11), 2234–2248. <https://doi.org/10.1111/acer.12886>
- Kairouz, S., Gliksman, L., Demers, A., & Adlaf, E. M. (2002). For all these reasons, I do...drink: a multilevel analysis of contextual reasons for drinking among Canadian undergraduates. *Journal of Studies on Alcohol*, 63(5), 600–608. <https://doi.org/10.15288/JSA.2002.63.600>
- Kaminskaite, M., Prankeviciene, A., Bunevicius, A., Janaviciute, J., Jokubonis, D., Pliplyte, A., Lelyte, I., Sinkariova, L., & Jokubka, R. (2020). Validation of the Substance Use Risk Profile Scale in Lithuanian population. *Health and Quality of Life Outcomes*, 18(1), 276. <https://doi.org/10.1186/s12955-020-01527-5>
- Kelly, T. M., & Daley, D. C. (2013). Integrated Treatment of Substance Use and Psychiatric Disorders. *Social Work in Public Health*, 28(0), 388. <https://doi.org/10.1080/19371918.2013.774673>
- Kennedy, A. P., Phillips, K. A., Epstein, D. H., Reamer, D. A., Schmittner, J., & Preston, K. L. (2013). A randomized investigation of methadone doses at or over 100mg/day, combined with contingency management. *Drug and Alcohol Dependence*, 130(1–3), 77–84. <https://doi.org/10.1016/j.drugalcdep.2012.10.025>
- Kerr, T., Fairbairn, N., Tyndall, M., Marsh, D., Li, K., Montaner, J., & Wood, E. (2007). Predictors of non-fatal overdose among a cohort of polysubstance-using injection drug users. *Drug and Alcohol Dependence*, 87(1), 39–45. <https://doi.org/10.1016/j.drugalcdep.2006.07.009>
- Keyes, K. M., Hatzenbuehler, M. L., & Hasin, D. S. (2011). Stressful life experiences, alcohol consumption, and alcohol use disorders: the epidemiologic evidence for four main types of stressors. *Psychopharmacology 2011 218:1*, 218(1), 1–17. <https://doi.org/10.1007/S00213-011-2236-1>
- Khantzian, E. J. (1997). The self-medication hypothesis of substance use disorders: a reconsideration and recent applications. *Harvard Review of Psychiatry*, 4(5), 231–244. <https://doi.org/10.3109/10673229709030550>
- Kidorf, M., Disney, E. R., King, V. L., Neufeld, K., Beilenson, P. L., & Brooner, R. K. (2004). Prevalence of psychiatric and substance use disorders in opioid abusers in a community syringe exchange program. *Drug and Alcohol Dependence*, 74(2), 115–122. <https://doi.org/10.1016/j.drugalcdep.2003.11.014>
- Kilpatrick, D. G., Acierno, R., Resnick, H. S., Saunders, B. E., & Best, C. L. (1997). A 2-year longitudinal analysis of the relationships between violent assault and substance use in women. *Journal of Consulting and Clinical Psychology*, 65(5), 834–847. <https://doi.org/10.1037/0022-006X.65.5.834>

- Kirby, K. N., & Finch, J. C. (2010). The hierarchical structure of self-reported impulsivity. *Personality and Individual Differences, 48*(6), 704. <https://doi.org/10.1016/J.PAID.2010.01.019>
- Klein, D. N., Kotov, R., & Bufferd, S. J. (2011). Personality and Depression: Explanatory Models and Review of the Evidence. *Annual Review of Clinical Psychology, 7*, 269. <https://doi.org/10.1146/ANNUREV-CLINPSY-032210-104540>
- Kleykamp, B. A., Vandrey, R. G., Bigelow, G. E., Strain, E. C., & Mintzer, M. Z. (2015). Effects of methadone plus alcohol on cognitive performance in methadone-maintained volunteers. *The American Journal of Drug and Alcohol Abuse, 41*(3), 251. <https://doi.org/10.3109/00952990.2014.987348>
- Konkolý Thege, B., Horwood, L., Slater, L., Tan, M. C., Hodgins, D. C., & Wild, T. C. (2017). Relationship between interpersonal trauma exposure and addictive behaviors: A systematic review. *BMC Psychiatry, 17*(1), 1–17. <https://doi.org/10.1186/S12888-017-1323-1/TABLES/6>
- Koob, G. F., Buck, C. L., Cohen, A., Edwards, S., Park, P. E., Schlosburg, J. E., Schmeichel, B., Vendruscolo, L. F., Wade, C. L., Whitfield, T. W., & George, O. (2014). Addiction as a stress surfeit disorder. *Neuropharmacology, 76*, 370–382. <https://doi.org/10.1016/j.neuropharm.2013.05.024>
- Koob, G. F., & Volkow, N. D. (2010). Neurocircuitry of addiction. *Neuropsychopharmacology : Official Publication of the American College of Neuropsychopharmacology, 35*(1), 217–238. <https://doi.org/10.1038/npp.2009.110>
- Kornør, H., & Nordvik, H. (2007). Five-factor model personality traits in opioid dependence. *BMC Psychiatry, 7*(1), 37. <https://doi.org/10.1186/1471-244X-7-37>
- Kosten, T. R., & Baxter, L. E. (2019). Review article: Effective management of opioid withdrawal symptoms: A gateway to opioid dependence treatment. *The American Journal on Addictions, 28*(2), 55. <https://doi.org/10.1111/AJAD.12862>
- Kosten, T. R., & O'Connor, P. G. (2003). *Management of Drug and Alcohol Withdrawal*. www.nejm.org
- Krank, M., Stewart, S. H., O'Connor, R., Woicik, P. B., Wall, A.-M. M., & Conrod, P. J. (2011). Structural, concurrent, and predictive validity of the Substance Use Risk Profile Scale in early adolescence. *Addictive Behaviors, 36*(1), 37–46. <https://doi.org/10.1016/j.addbeh.2010.08.010>
- Kreek, M. J., & Koob, G. F. (1998). Drug dependence: Stress and dysregulation of brain reward pathways. *Drug and Alcohol Dependence, 51*(1–2), 23–47. [https://doi.org/10.1016/S0376-8716\(98\)00064-7](https://doi.org/10.1016/S0376-8716(98)00064-7)
- Krueger, R. F., & Eaton, N. R. (2010). Personality traits and the classification of mental disorders: Toward a more complete integration in DSM-5 and an empirical model of psychopathology. *Personality Disorders: Theory, Research, and Treatment, 1*(2), 97–118. <https://doi.org/10.1037/a0018990>

- Kruschke, J. K., & Liddell, T. M. (2017). The Bayesian New Statistics: Hypothesis testing, estimation, meta-analysis, and power analysis from a Bayesian perspective. *Psychonomic Bulletin & Review* 25:1, 25(1), 178–206. <https://doi.org/10.3758/S13423-016-1221-4>
- Kubzansky, L. D., Davidson, K. W., & Rozanski, A. (2005). The clinical impact of negative psychological states: Expanding the spectrum of risk for coronary artery disease. *Psychosomatic Medicine*, 67(SUPPL. 1). <https://doi.org/10.1097/01.PSY.0000164012.88829.41>
- Kumar, R. N., Chambers, W. A., & Pertwee, R. G. (2001). Pharmacological actions and therapeutic uses of cannabis and cannabinoids. *Anaesthesia*, 56(11), 1059–1068. <https://doi.org/10.1111/j.1365-2044.2001.02269.x>
- Kurdyak, P., Gomes, T., Yao, Z., Mamdani, M. M., Hellings, C., Fischer, B., Rehm, J., Bayoumi, A. M., & Juurlink, D. N. (2012). Use of other opioids during methadone therapy: a population-based study. *Addiction (Abingdon, England)*, 107(4), 776–780. <https://doi.org/10.1111/J.1360-0443.2011.03707.X>
- Langleben, D. D., Ruparel, K., Elman, I., Busch-Winokur, S., Pratiwadi, R., Loughead, J., O'Brien, C. P., & Childress, A. R. (2008). Acute effect of methadone maintenance dose on brain fMRI response to heroin-related cues. *American Journal of Psychiatry*, 165(3), 390–394. <https://doi.org/10.1176/appi.ajp.2007.07010070>
- Lazarus, R. S., & Folkman, S. (1984). *Stress, appraisal, and coping*. Springer publishing company.
- Lee, C. M., Neighbors, C., Hendershot, C. S., & Grossbard, J. R. (2009). Development and Preliminary Validation of a Comprehensive Marijuana Motives Questionnaire. *Journal of Studies on Alcohol and Drugs*, 70(2), 279. <https://doi.org/10.15288/JSAD.2009.70.279>
- Lejuez, C. W., Paulson, A., Daughters, S. B., Bornovalova, M. A., & Zvolensky, M. J. (2006). The association between heroin use and anxiety sensitivity among inner-city individuals in residential drug use treatment. *Behaviour Research and Therapy*, 44(5), 667–677. <https://doi.org/10.1016/J.BRAT.2005.04.006>
- Lejuez, C. W., Zvolensky, M. J., Daughters, S. B., Bornovalova, M. A., Paulson, A., Tull, M. T., Ettinger, K., & Otto, M. W. (2008). Anxiety sensitivity: A unique predictor of dropout among inner-city heroin and crack/cocaine users in residential substance use treatment. *Behaviour Research and Therapy*, 46(7), 811–818. <https://doi.org/10.1016/j.brat.2008.03.010>
- Leventhal, A. M., & Schmitz, J. M. (2006). The role of drug use outcome expectancies in substance abuse risk: An interactional–transformational model. *Addictive Behaviors*, 31(11), 2038–2062. <https://doi.org/10.1016/J.ADDBEH.2006.02.004>
- Leyton, M., & Stewart, S. H. (2014). *Substance Abuse in Canada: Childhood and adolescent pathways to substance use disorders*. <https://www.ccsa.ca/%0Asites/default/files/2019-04/CCSA-Child-Adolescent-Substance-Use-Disorders-%0AReport-2014-en.pdf>

- Li, J., Weidacker, K., Mandali, A., Zhang, Y., Whiteford, S., Ren, Q., Zhou, Z., Zhou, H., Jiang, H., Du, J., Zhang, C., Sun, B., & Voon, V. (2021). Impulsivity and craving in subjects with opioid use disorder on methadone maintenance treatment. *Drug and Alcohol Dependence*, 219. <https://doi.org/10.1016/j.drugalcdep.2020.108483>
- Liddell, T. M., & Kruschke, J. K. (2018). Analyzing ordinal data with metric models: What could possibly go wrong? *Journal of Experimental Social Psychology*, 79(September), 328–348. <https://doi.org/10.1016/j.jesp.2018.08.009>
- Liebrenz, M., Schneider, M., Buadze, A., Gehring, M. T., Dube, A., & Caflisch, C. (2015). High-dose benzodiazepine dependence: A qualitative study of patients' perceptions on initiation, reasons for use, and obtainment. *PLoS ONE*, 10(11). <https://doi.org/10.1371/journal.pone.0142057>
- Ling, W., Jacobs, P., Hillhouse, M., Hasson, A., Thomas, C., Freese, T., Sparenborg, S., McCarty, D., Weiss, R., Saxon, A., Cohen, A., Straus, M., Brigham, G., Liu, D., McLaughlin, P., & Tai, B. (2010). From Research to the Real World: Buprenorphine in the Decade of the Clinical Trials Network. *Journal of Substance Abuse Treatment*, 38(Suppl 1), S53. <https://doi.org/10.1016/J.JSAT.2010.01.009>
- Lintzeris, N., Mitchell, T. B., Bond, A., Nestor, L., & Strang, J. (2006). Interactions on mixing diazepam with methadone or buprenorphine in maintenance patients. *Journal of Clinical Psychopharmacology*, 26(3), 274–283. <https://doi.org/10.1097/01.jcp.0000219050.33008.61>
- Liu, X., Jin, X., Zhang, Y., Zhang, L., Li, Y., & Ma, J. (2021). Effect of Coronavirus Disease 2019 on the Psychology and Behavior of Patients on Methadone Maintenance Treatment in Wuhan, China: A Clinical Observational Study. *Frontiers in Psychiatry*, 12, 406. <https://doi.org/10.3389/FPSYT.2021.653662/BIBTEX>
- Long, E. C., Kaneva, R., Vasilev, G., Moeller, F. G., & Vassileva, J. (2020). Neurocognitive and Psychiatric Markers for Addiction: Common vs. Specific Endophenotypes for Heroin and Amphetamine Dependence. *Current Topics in Medicinal Chemistry*, 20(7), 585–597. <https://doi.org/10.2174/1568026620666200131124608>
- Long, E. C., Milcheva, S., Psederska, E., Vasilev, G., Bozgunov, K., Nedelchev, D., Gillespie, N. A., & Vassileva, J. (2018). Validation of the Substance Use Risk Profile Scale (SURPS) With Bulgarian Substance Dependent Individuals. *Frontiers in Psychology*, 9, 2296. <https://doi.org/10.3389/fpsyg.2018.02296>
- Low, K. G., & Gendaszek, A. E. (2010). Illicit use of psychostimulants among college students: A preliminary study. *Http://Dx.Doi.Org/10.1080/13548500220139386*, 7(3), 283–287. <https://doi.org/10.1080/13548500220139386>
- Lucas, P. (2017). Rationale for cannabis-based interventions in the opioid overdose crisis. *Harm Reduction Journal*, 14(1), 58. <https://doi.org/10.1186/s12954-017-0183-9>

- Mackay, L., Bach, P., Milloy, M. J., Cui, Z., Kerr, T., & Hayashi, K. (2021). The relationship between crystal methamphetamine use and methadone retention in a prospective cohort of people who use drugs. *Drug and Alcohol Dependence*, 225. <https://doi.org/10.1016/J.DRUGALCDEP.2021.108844>
- Mackinnon, S. P., Kehayes, I. L. L., Clark, R., Sherry, S. B., & Stewart, S. H. (2014). Testing the four-factor model of personality vulnerability to alcohol misuse: A three-wave, one-year longitudinal study. *Psychology of Addictive Behaviors*, 28(4), 1000–1012. <https://doi.org/10.1037/a0037244>
- 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. *Addictive Behaviors*, 68, 35–38. <https://doi.org/10.1016/j.addbeh.2017.01.014>
- MacNeill, L., Brunelle, C., DiTommaso, E., & Skelding, B. (2019). Client characteristics and substance use patterns in different models of methadone maintenance therapy (MMT). <https://doi.org/10.1080/14659891.2019.1704083>, 25(4), 377–381. <https://doi.org/10.1080/14659891.2019.1704083>
- MacNeill, L., Brunelle, C., Skelding, B., & DiTommaso, E. (2020). Experiences of Clients in Three Types of Methadone Maintenance Therapy in an Atlantic Canadian City: A Qualitative Study: <https://doi.org/10.1177/0844562120924516>, 084456212092451. <https://doi.org/10.1177/0844562120924516>
- Mahu, I. T., Barrett, S. P., Conrod, P. J., Bartel, S. J., & Stewart, S. H. (2021). Different drugs come with different motives: Examining motives for substance use among people who engage in polysubstance use undergoing methadone maintenance therapy (MMT). *Drug and Alcohol Dependence*, 229(Pt B), 109133. <https://doi.org/10.1016/j.drugalcdep.2021.109133>
- Mahu, I. T., Barrett, S. P., Peters, L. R., Fulton, H. G., & Stewart, S. H. (2016). Personality Traits and Methadone Dose and Compliance Independently Predict Concurrent Substance Use in Clients Undergoing Methadone Maintenance Treatment for Opiate Addiction. *Journal of Addiction Medicine*, 28. https://journals.lww.com/cja/Citation/2016/12000/PERSONALITY_TRAITS_AND_METHADONE_DOSE_AND.13.aspx
- Mahu, I. T., Conrod, P. J., Barrett, S. P., MacIsaac, C., Sako, A., Swansburg, J., Morin, J.-F., Laroque, F., & Stewart, S. H. (2019). Practitioner and Client Perspectives on Adapting Personality Targeted Interventions for Use as an Adjunct to Methadone Maintenance Therapy. *CCSA Issues of Substance*.
- Mahu, I. T., Conrod, P. J., Barrett, S. P., Sako, A., Swansburg, J., Lawrence, M., Laroque, F., Morin, J.-F., Chinneck, A., Nogueira-Arjona, R., & Stewart, S. H. (2019). Specificity of personality relationships to particular forms of concurrent substance use among methadone maintenance therapy clients. *Addictive Behaviors*, 98(March), 106056. <https://doi.org/10.1016/j.addbeh.2019.106056>

- Mahu, I. T., Doucet, C., O’Leary-Barrett, M., & Conrod, P. J. (2015). Can cannabis use be prevented by targeting personality risk in schools? Twenty-four-month outcome of the adventure trial on cannabis use: a cluster-randomized controlled trial. *Addiction, 110*(10), 1625–1633. <https://doi.org/10.1111/add.12991>
- Mateu-Gelabert, P., Jessell, L., Goodbody, E., Kim, D., Gile, K., Teubl, J., Syckes, C., Ruggles, K., Lazar, J., Friedman, S., & Guarino, H. (2017). High enhancer, downer, withdrawal helper: Multifunctional nonmedical benzodiazepine use among young adult opioid users in New York City. *International Journal of Drug Policy, 46*, 17–27. <https://doi.org/10.1016/j.drugpo.2017.05.016>
- Mattick, R. P., Breen, C., Kimber, J., & Davoli, M. (2014). Buprenorphine maintenance versus placebo or methadone maintenance for opioid dependence. *Cochrane Database of Systematic Reviews, 2014*(2). <https://doi.org/10.1002/14651858.CD002207.pub4>
- Mattson, C. L., Tanz, L. J., Quinn, K., Kariisa, M., Patel, P., & Davis, N. L. (2021). Trends and Geographic Patterns in Drug and Synthetic Opioid Overdose Deaths — United States, 2013–2019. *MMWR. Morbidity and Mortality Weekly Report, 70*(6), 202–207. <https://doi.org/10.15585/MMWR.MM7006A4>
- Mayet, A., Lions, C., Roux, P., Mora, M., Maradan, G., Morel, A., Michel, L., Marimoutou, C., & Carrieri, M. P. (2015). Variations in Cannabis Use Level and Correlates in Opiate-Users on Methadone Maintenance Treatment: A French Prospective Study. *Journal of Substance Abuse Treatment, 58*, 100–105. <https://doi.org/10.1016/J.JSAT.2015.06.015>
- McBrien, H., Luo, C., Sanger, N., Zielinski, L., Bhatt, M., Zhu, X. M., Marsh, D. C., Thabane, L., & Samaan, Z. (2019). Cannabis use during methadone maintenance treatment for opioid use disorder: a systematic review and meta-analysis. *Canadian Medical Association Open Access Journal, 7*(4), E665–E673. <https://doi.org/10.9778/CMAJO.20190026>
- McCrae, R. R., & Costa, P. T. (1987). Validation of the Five-Factor Model of Personality Across Instruments and Observers. *Journal of Personality and Social Psychology, 52*(1), 81–90.
- McCrae, R. R., & Costa, P. T. (1994). The stability of personality: Observations and evaluations. *Current Directions in Psychological Science, 3*(6), 173–175.
- McFarlane, A. C. (1998). Epidemiological evidence about the relationship between PTSD and alcohol abuse: The nature of the association. *Addictive Behaviors, 23*(6), 813–825. [https://doi.org/10.1016/S0306-4603\(98\)00098-7](https://doi.org/10.1016/S0306-4603(98)00098-7)
- McHugh, R. K., Votaw, V. R., Bogunovic, O., Karakula, S. L., Griffin, M. L., & Weiss, R. D. (2017). Anxiety sensitivity and nonmedical benzodiazepine use among adults with opioid use disorder. *Addictive Behaviors, 65*, 283–288. <https://doi.org/10.1016/j.addbeh.2016.08.020>
- McLaughlin, I., Dani, J. A., & De Biasi, M. (2015). Nicotine Withdrawal. *Current Topics in Behavioral Neurosciences, 24*, 99. https://doi.org/10.1007/978-3-319-13482-6_4

- McNally, R. J. (1989). Is Anxiety Sensitivity Distinguishable From Trait Anxiety? Reply to Lilienfeld, Jacob, and Turner (1989). *Journal of Abnormal Psychology, 98*(2), 193–194. <https://doi.org/10.1037/0021-843X.98.2.193>
- McNally, R. J. (2002). Anxiety sensitivity and panic disorder. *Biological Psychiatry, 52*(10), 938–946. [https://doi.org/10.1016/S0006-3223\(02\)01475-0](https://doi.org/10.1016/S0006-3223(02)01475-0)
- Mendez, I. A., Simon, N. W., Hart, N., Mitchell, M. R., Nation, J. R., Wellman, P. J., & Setlow, B. (2010). Self-administered cocaine causes long-lasting increases in impulsive choice in a delay discounting task. *Behavioral Neuroscience, 124*(4), 470–477. <https://doi.org/10.1037/a0020458>
- 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. *European Addiction Research, 17*(5), 250–261. <https://doi.org/10.1159/000328510>
- Miller, A., & Ireland, N. (2017). 2,000% rise in street drug samples testing positive for fentanyl. CBC News. <https://www.cbc.ca/news/health/shocking-rise-of-fentanyl-in-seized-street-drugs-1.4393906>
- Mitchell, M. R., & Potenza, M. N. (2014). Addictions and Personality Traits: Impulsivity and Related Constructs. *Current Behavioral Neuroscience Reports, 1*(1), 1–12. <https://doi.org/10.1007/s40473-013-0001-y>
- Morales, P., Hurst, D. P., & Reggio, P. H. (2017). Molecular Targets of the Phytocannabinoids: A Complex Picture. *Progress in the Chemistry of Organic Natural Products, 103*, 103–131. https://doi.org/10.1007/978-3-319-45541-9_4
- Morin, K. A., Eibl, J. K., Gauthier, G., Rush, B., Mushquash, C., Lightfoot, N. E., & Marsh, D. C. (2020). A cohort study evaluating the association between concurrent mental disorders, mortality, morbidity, and continuous treatment retention for patients in opioid agonist treatment (OAT) across Ontario, Canada, using administrative health data. *Harm Reduction Journal 2020 17:1, 17*(1), 1–13. <https://doi.org/10.1186/S12954-020-00396-X>
- Movsisyan, A., Arnold, L., Copeland, L., Evans, R., Littlecott, H., Moore, G., O’Cathain, A., Pfadenhauer, L., Segrott, J., & Rehfuss, E. (2021). Adapting evidence-informed population health interventions for new contexts: a scoping review of current practice. *Health Research Policy and Systems, 19*(1). <https://doi.org/10.1186/S12961-020-00668-9>
- Mushquash, C. J., Comeau, M. N., & Stewart, S. H. (2020). An Alcohol Abuse Early Intervention Approach with Mi’kmaq Adolescents. *First Peoples Child & Family Review, 3*(2), 17–26. <https://doi.org/10.7202/1069458ar>
- Newton, N. C., Barrett, E. L., Castellanos-Ryan, N., Kelly, E., Champion, K. E., Stapinski, L., Conrod, P. J., Slade, T., Nair, N., & Teesson, M. (2016). The validity of the Substance Use Risk Profile Scale (SURPS) among Australian adolescents. *Addictive Behaviors, 53*, 23–30. <https://doi.org/10.1016/j.addbeh.2015.09.015>

- Nosyk, B., Fischer, B., Sun, H., Marsh, D. C., Kerr, T., Rehm, J. T., & Anis, A. H. (2014). High levels of opioid analgesic co-prescription among methadone maintenance treatment clients in British Columbia, Canada: results from a population-level retrospective cohort study. *The American Journal on Addictions, 23*(3), 257–264. <https://doi.org/10.1111/J.1521-0391.2014.12091.X>
- O'Hare, T., & Shen, C. (2012). Substance Use Motives and Severe Mental Illness. *Journal of Dual Diagnosis, 8*(3), 171–179. <https://doi.org/10.1080/15504263.2012.696184>
- Olthuis, J. V., Watt, M. C., Mackinnon, S. P., & Stewart, S. H. (2014). Telephone-delivered cognitive behavioral therapy for high anxiety sensitivity: A randomized controlled trial. *Journal of Consulting and Clinical Psychology, 82*(6), 1005–1022. <https://doi.org/10.1037/a0037027>
- Omiya, S., Kobori, O., Tomoto, A., Igarashi, Y., & Iyo, M. (2015). Personality and substance use in Japanese adolescents: The Japanese version of Substance Use Risk Profile Scale. *Personality and Individual Differences, 76*, 153–157. <https://doi.org/10.1016/j.paid.2014.11.034>
- Ormel, J., Jeronimus, B. F., Kotov, R., Riese, H., Bos, E. H., Hankin, B., Rosmalen, J. G. M., & Oldehinkel, A. J. (2013). Neuroticism and Common Mental Disorders: Meaning and Utility of a Complex Relationship. *Clinical Psychology Review, 33*(5), 686. <https://doi.org/10.1016/J.CPR.2013.04.003>
- Ormel, J., Oldehinkel, A. J., & Vollebergh, W. (2004). Vulnerability before, during, and after a major depressive episode: a 3-wave population-based study. *Archives of General Psychiatry, 61*(10), 990–996. <https://doi.org/10.1001/ARCHPSYC.61.10.990>
- Öster, C., Arinell, H., & Nehlin, C. (2017). The Drinking Motives Questionnaire among Swedish psychiatric patients: An exploration of the four-factor structure. *Drug and Alcohol Review, 36*(3), 400–407. <https://doi.org/10.1111/dar.12421>
- Oswald, L. M., Dunn, K. E., Seminowicz, D. A., & Storr, C. L. (2021). Early Life Stress and Risks for Opioid Misuse: Review of Data Supporting Neurobiological Underpinnings. *Journal of Personalized Medicine, 11*(4). <https://doi.org/10.3390/JPM11040315>
- Pathan, H., & Williams, J. (2012). Basic opioid pharmacology: an update. *British Journal of Pain, 6*(1), 11. <https://doi.org/10.1177/2049463712438493>
- Patton, J. H., Stanford, M. S., & Barratt, E. S. (1995). Factor structure of the Barratt impulsiveness scale. *Journal of Clinical Psychology, 51*(6), 768–774.
- Peluso, M. A. M., Hatch, J. P., Glahn, D. C., Monkul, E. S., Sanches, M., Najt, P., Bowden, C. L., Barratt, E. S., & Soares, J. C. (2007). Trait impulsivity in patients with mood disorders. *Journal of Affective Disorders, 100*(1–3), 227–231. <https://doi.org/10.1016/j.jad.2006.09.037>

- Peterson, R. A., & Reiss, S. (1992). *The anxiety sensitivity index manual* (2nd ed.). International Diagnostic Systems.
- Pihl, R. O., & Peterson, J. B. (1995). Alcoholism: The role of different motivational systems. *Journal of Psychiatry and Neuroscience*, 20(5), 372–396.
- Quello, S. B., Brady, K. T., & Sonne, S. C. (2005). Mood Disorders and Substance Use Disorder: A Complex Comorbidity. *Science & Practice Perspectives*, 3(1), 13. <https://doi.org/10.1151/SPP053113>
- Quinn, P. D., & Harden, K. P. (2013). Differential Changes in Impulsivity and Sensation Seeking and the Escalation of Substance Use from Adolescence to Early Adulthood. *Development and Psychopathology*, 25(1), 223. <https://doi.org/10.1017/S0954579412000284>
- Quinn, P. D., Stappenbeck, C. A., & Fromme, K. (2011). Collegiate Heavy Drinking Prospectively Predicts Change in Sensation Seeking and Impulsivity. *Journal of Abnormal Psychology*, 120(3), 543. <https://doi.org/10.1037/A0023159>
- R Core Team. (2013). *R: A language and environment for statistical computing*. R Foundation for Statistical Computing. <http://www.r-project.org/>
- Reise, S. P., Moore, T. M., Sabb, F. W., Brown, A. K., & London, E. D. (2013). The Barratt Impulsiveness Scale - 11: Reassessment of its Structure in a Community Sample. *Psychological Assessment*, 25(2), 631. <https://doi.org/10.1037/A0032161>
- Reiss, S., Peterson, R. A., Gursky, D. M., & McNally, R. J. (1986). Anxiety sensitivity, anxiety frequency and the predictions of fearfulness. In *Behaviour Research and Therapy* (Vol. 24, Issue 1, pp. 1–8). Elsevier Science. [https://doi.org/10.1016/0005-7967\(86\)90143-9](https://doi.org/10.1016/0005-7967(86)90143-9)
- Rigg, K. K., & Ibañez, G. E. (2010). Motivations for non-medical prescription drug use: A mixed methods analysis. *Journal of Substance Abuse Treatment*, 39(3), 236–247. <https://doi.org/10.1016/j.jsat.2010.06.004>
- Rigotti, N. A., Kruse, G. R., Livingstone-Banks, J., & Hartmann-Boyce, J. (2022). Treatment of Tobacco Smoking: A Review. *JAMA*, 327(6), 566–577. <https://doi.org/10.1001/JAMA.2022.0395>
- Roberti, J. W. (2004). A review of behavioral and biological correlates of sensation seeking. *Journal of Research in Personality*, 38(3), 256–279. [https://doi.org/10.1016/S0092-6566\(03\)00067-9](https://doi.org/10.1016/S0092-6566(03)00067-9)
- Roberts, B. W., & DelVecchio, W. F. (2000). The rank-order consistency of personality traits from childhood to old age: a quantitative review of longitudinal studies. *Psychological Bulletin*, 126(1), 3–25. <https://doi.org/10.1037/0033-2909.126.1.3>
- Roberts, B. W., Walton, K. E., & Viechtbauer, W. (2006). Patterns of mean-level change in personality traits across the life course: a meta-analysis of longitudinal studies. *Psychological Bulletin*, 132(1), 1–25. <https://doi.org/10.1037/0033-2909.132.1.1>

- Robles-García, R., Fresán, A., Castellanos-Ryan, N., Conrod, P. J., Gómez, D., de Quevedo y Domínguez, M. E. G., Rafful, C., Real, T., Vásquez, L., & Medina-Mora, M. E. (2014). Spanish version of the Substance Use Risk Profile Scale: Factor structure, reliability, and validity in Mexican adolescents. *Psychiatry Research*, 220(3), 1113–1117. <https://doi.org/10.1016/j.psychres.2014.08.057>
- Rodríguez-Llera, M. C., Domingo-Salvany, A., Brugal, M. T., Silva, T. C., Sánchez-Niubó, A., & Torrens, M. (2006). Psychiatric comorbidity in young heroin users. *Drug and Alcohol Dependence*, 84(1), 48–55. <https://doi.org/10.1016/j.drugalcdep.2005.11.025>
- Rogers, A. H., Garey, L., Raines, A. M., Allan, N. P., Schmidt, N. B., & Zvolensky, M. J. (2020). Anxiety Sensitivity and Opioid Use Motives Among Adults With Chronic Low Back Pain. *Experimental and Clinical Psychopharmacology*. <https://doi.org/10.1037/pha0000381>
- Rogers, A. H., Kauffman, B. Y., Bakhshaie, J., McHugh, R. K., Ditre, J. W., & Zvolensky, M. J. (2019). Anxiety sensitivity and opioid misuse among opioid-using adults with chronic pain. *The American Journal of Drug and Alcohol Abuse*, 1–9. <https://doi.org/10.1080/00952990.2019.1569670>
- Rosenberg, M. (1965). *Society and the adolescent self-image*. Princeton University Press.
- Rosic, T., Kapoor, R., Panesar, B., Naji, L., Chai, D. B., Sanger, N., Marsh, D. C., Worster, A., Thabane, L., & Samaan, Z. (2021). The association between cannabis use and outcome in pharmacological treatment for opioid use disorder. *Harm Reduction Journal*, 18(1). <https://doi.org/10.1186/S12954-021-00468-6>
- Rosic, T., Sanger, N., Panesar, B., Foster, G., Marsh, D. C., Rieb, L., Thabane, L., Worster, A., & Samaan, Z. (2021). Cannabis use in patients treated for opioid use disorder pre- and post-recreational cannabis legalization in Canada. *Substance Abuse: Treatment, Prevention, and Policy*, 16(1), 1–11. <https://doi.org/10.1186/S13011-021-00372-Z/TABLES/6>
- Rouder, J. N. (2014). Optional stopping: no problem for Bayesians. *Psychonomic Bulletin & Review*, 21(2), 301–308. <https://doi.org/10.3758/s13423-014-0595-4>
- Rouine, J., Callaghan, C. K., & O'Mara, S. M. (2018). Opioid modulation of depression: A focus on imaging studies. In *Progress in Brain Research* (Vol. 239, pp. 229–252). Elsevier B.V. <https://doi.org/10.1016/bs.pbr.2018.09.007>
- Saunders, B., Sim, J., Kingstone, T., Baker, S., Waterfield, J., Bartlam, B., Burroughs, H., & Jinks, C. (2018). Saturation in qualitative research: exploring its conceptualization and operationalization. *Quality and Quantity*, 52(4), 1893–1907. <https://doi.org/10.1007/s11135-017-0574-8>
- Saunders, E. C., Moore, S. K., Walsh, O., Metcalf, S. A., Budney, A. J., Cavazos-Rehg, P., Scherer, E., & Marsch, L. A. (2021). “It’s way more than just writing a prescription”: A qualitative study of preferences for integrated versus non-integrated treatment models among individuals with opioid use disorder. *Addiction Science & Clinical Practice*, 16(1). <https://doi.org/10.1186/S13722-021-00213-1>

- 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>
- Schepis, T. S., Wastila, L., Ammerman, B., McCabe, V. V., & McCabe, S. E. (2020). Prescription Opioid Misuse Motives in US Older Adults. *Pain Medicine (Malden, Mass.)*, *21*(10), 2237–2243. <https://doi.org/10.1093/pm/pnz304>
- 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. *Journal of Psychopathology and Behavioral Assessment*, *37*(2), 231–246. <https://doi.org/10.1007/s10862-014-9462-x>
- Schumacher, J. E., Milby, J. B., Fishman, B. E., & Huggins, N. (1992). Relation of detoxification fear to methadone maintenance outcome: 5-year follow-up. *Psychology of Addictive Behaviors*, *6*(1), 41–46. <https://doi.org/10.1037/H0080606>
- Schweinsburg, A. D., Brown, S. A., & Tapert, S. F. (2008). The influence of marijuana use on neurocognitive functioning in adolescents. *Current Drug Abuse Reviews*, *1*(1), 99–111.
- Seivewright, N. (2003). Methadone treatment outcomes appear mainly unaffected by cannabis use. *Addiction*, *98*(3), 251–252. <https://doi.org/10.1046/j.1360-0443.2003.00333.x>
- Setlow, B., Mendez, I. A., Mitchell, M. R., & Simon, N. W. (2009). Effects of chronic administration of drugs of abuse on impulsive choice (delay discounting) in animal models. *Behavioural Pharmacology*, *20*(5–6), 380–389. <https://doi.org/10.1097/FBP.0b013e3283305eb4>
- Shariatirad, S., Maarefvand, M., & Ekhtiari, H. (2013). Methamphetamine use and methadone maintenance treatment: an emerging problem in the drug addiction treatment network in Iran. *The International Journal on Drug Policy*, *24*(6). <https://doi.org/10.1016/J.DRUGPO.2013.05.003>
- Sheng, J., Liu, S., Wang, Y., Cui, R., & Zhang, X. (2017). The Link between Depression and Chronic Pain: Neural Mechanisms in the Brain. *Neural Plasticity*, *2017*. <https://doi.org/10.1155/2017/9724371>
- Sher, K. J. (1991). *Children of Alcoholics: A Critical Appraisal of Theory and Research*. University of Chicago Press.
- Sher, K. J., Grekin, E. R., & Williams, N. A. (2005). The Development of Alcohol Use Disorders. *Annu. Rev. Clin. Psychol.*, *1*, 493–523. <https://doi.org/10.1146/annurev.clinpsy.1.102803.144107>
- Sherman, M. F., & Bigelow, G. E. (1992). Validity of patients' self-reported drug use as a function of treatment status. *Drug and Alcohol Dependence*, *30*(1), 1–11. [https://doi.org/10.1016/0376-8716\(92\)90030-G](https://doi.org/10.1016/0376-8716(92)90030-G)

- Shiffman, S., Stone, A. A., & Hufford, M. R. (2008). Ecological momentary assessment. *Annual Review of Clinical Psychology, 4*, 1–32. <https://doi.org/10.1146/ANNUREV.CLINPSY.3.022806.091415>
- Simons, J., Correia, C. J., & Carey, K. B. (2000). A comparison of motives for marijuana and alcohol use among experienced users. *Addictive Behaviors, 25*(1), 153–160. [https://doi.org/10.1016/S0306-4603\(98\)00104-X](https://doi.org/10.1016/S0306-4603(98)00104-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. *Journal of Counseling Psychology, 45*(3), 265–273. <https://doi.org/10.1037/0022-0167.45.3.265>
- Singh, D., Mamat, R. Bin, Narayanan, S., & Vicknasingam, B. (2019). Prevalence of Amphetamine-Type Stimulants (ATS) use among clients in primary and private Methadone Maintenance Treatment (MMT) program in Kuantan, Malaysia. <https://doi.org/10.1080/14659891.2019.1642409>, *24*(6), 666–671. <https://doi.org/10.1080/14659891.2019.1642409>
- Siu, A. F. Y. (2011). Validation of the substance use risk profile scale for adolescents in hong kong. *Journal of Psychoeducational Assessment, 29*(1), 75–83. <https://doi.org/10.1177/0734282910362044>
- 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/s10899-010-9192-2>
- Socias, M. E., Wood, E., Lake, S., Nolan, S., Fairbairn, N., Hayashi, K., Shulha, H. P., Liu, S., Kerr, T., & 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>
- Special Advisory Committee on the Epidemic of Opioid Overdoses. (2018). *Statement from the Co-Chairs of the Special Advisory Committee on the Epidemic of Opioid Overdoses and the Canadian Institute for Health Information on Updates to Data Related to the Opioid Crisis*. <https://www.canada.ca/en/public-health/news/2018/06/statement-from-the-co-chairs-of-the-special-advisory-committee-on-the-epidemic-of-opioid-overdoses-and-the-canadian-institute-for-health-informatio.html>
- Special Advisory Committee on the Epidemic of Opioid Overdoses. (2022). *Opioid- and stimulant-related harms in Canada (March 2022)*. <https://health-infobase.canada.ca/substance-related-harms/opioids-stimulants/>
- Spencer, C., Castle, D., & Michie, P. T. (2002). Motivations That Maintain Substance Use Among Individuals With Psychotic Disorders. *Schizophrenia Bulletin, 28*(2), 233–247. <https://doi.org/10.1093/oxfordjournals.schbul.a006934>

- Spielberger, C. D., Gorsuch, R. L., Lushene, R., Vagg, P. R., & Jacobs, G. A. (1983). *Manual for the State-Trait Anxiety Inventory*. Consulting Psychologists Press. www.mindgarden.com.
- Staiger, P. K., Kambouropoulos, N., & Dawe, S. (2007). Should personality traits be considered when refining substance misuse treatment programs? *Drug and Alcohol Review, 26*(1), 17–23. <https://doi.org/10.1080/09595230601036952>
- Stan Development Team. (2020). *Rstan: the R interface to Stan* (R package version 2.21.2). <http://mc-stan.org/>
- Stathopoulou, G., Gold, A. K., Hoyt, D. L., Milligan, M., Hearon, B. A., & Otto, M. W. (2021). Does anxiety sensitivity predict addiction severity in opioid use disorder? *Addictive Behaviors, 112*, 106644. <https://doi.org/10.1016/J.ADDBEH.2020.106644>
- Stein, M. D., Kanabar, M., Anderson, B. J., Lembke, A., & Bailey, G. L. (2016). Reasons for Benzodiazepine use Among Persons Seeking Opioid Detoxification. *Journal of Substance Abuse Treatment, 68*, 57–61. <https://doi.org/10.1016/j.jsat.2016.06.008>
- Stewart, S. H., Chinneck, A., & Mahu, I. (2018). What is the role of personality in problematic opioid use? *Psynopsis, 40*(2), 16–19.
- Stewart, S. H., Chinneck, A., Thompson, K., Afzali, M. H., Nogueira-Arjona, R., Mahu, I. T., & Conrod, P. J. (2021). Personality to Prescription Drug Misuse in Adolescents: Testing Affect Regulation, Psychological Dysregulation, and Deviance Proneness Pathways. *Frontiers in Psychiatry, 0*, 474. <https://doi.org/10.3389/FPSYT.2021.640766>
- Stewart, S. H., & Conrod, P. J. (2003). Psychosocial models of functional associations between posttraumatic stress disorder and substance use disorder. In P. C. Ouimette & P. J. Brown (Eds.), *Trauma and substance abuse: Causes, consequences, and treatment of comorbid disorders* (pp. 29–56). American Psychological Association (APA).
- Stewart, S. H., & Conrod, P. J. (2008). Anxiety Disorder and Substance Use Disorder Co-Morbidity: Common Themes and Future Directions. In S. H. Stewart & P. J. Conrod (Eds.), *Anxiety and Substance Use Disorders: The Vicious Cycle of Comorbidity* (pp. 239–257). Springer.
- Stewart, S. H., Conrod, P. J., Barrett, S., Brissette, S., Brunelle, C., Corkum, P., Davidson, S., MacIsaac, C., Mahu, I. T., Olthuis, J., Webster, D., Sako, A., & Swansburg, J. (2021). *Personality-targeted interventions for addressing polysubstance use among opioid-addicted clients undergoing opioid substitution therapy: A feasibility study*.
- Stewart, S. H., Karp, J., Pihl, R. O., & Peterson, R. A. (1997). Anxiety sensitivity and self-reported reasons for drug use. *Journal of Substance Abuse, 9*(1), 223–240. [https://doi.org/10.1016/S0899-3289\(97\)90018-3](https://doi.org/10.1016/S0899-3289(97)90018-3)

- Stewart, S. H., & Kushner, M. G. (2001). Introduction to the special issue on “Anxiety Sensitivity and Addictive Behaviors.” *Addictive Behaviors*, *26*(6), 775–785. [https://doi.org/10.1016/S0306-4603\(01\)00236-2](https://doi.org/10.1016/S0306-4603(01)00236-2)
- Stewart, S. H., Lambe, L., Yunus, F., Noguiera-Arjona, R., Keough, M., Thompson, K., Krank, M., Rose, K., Wallis, C., Livet, A., & Conrod, P. J. (2022). Personality-targeted intervention effects on pandemic distress and coping drinking in undergraduates: A pilot study of UniVenture. *Annual Meeting of the International Behavioral Trials Network*.
- Stewart, S. H., Pihl, R. O., Conrod, P. J., & Dongier, M. (1998). Functional associations among trauma, PTSD, and substance-related disorders. *Addictive Behaviors*, *23*(6), 797–812. [https://doi.org/10.1016/S0306-4603\(98\)00070-7](https://doi.org/10.1016/S0306-4603(98)00070-7)
- Stewart, S. H., Samoluk, S. B., & MacDonald, A. B. (1999). Anxiety sensitivity and substance use and abuse. In *Anxiety sensitivity: Theory, research, and treatment of the fear of anxiety*. (pp. 287–319). Lawrence Erlbaum Associates Publishers.
- Stitzer, M. L., Griffiths, R. R., McLellan, A. T., Grabowski, J., & Hawthorne, J. W. (1981). Diazepam use among methadone maintenance patients: patterns and dosages. *Drug and Alcohol Dependence*, *8*(3), 189–199. [https://doi.org/10.1016/0376-8716\(81\)90061-2](https://doi.org/10.1016/0376-8716(81)90061-2)
- Sturgeon, J. A. (2014). Psychological therapies for the management of chronic pain. *Psychology Research and Behavior Management*, *7*, 115. <https://doi.org/10.2147/PRBM.S44762>
- Svicher, A., Zvolensky, M. J., & Cosci, F. (2018). Study of the relationship between anxiety sensitivity, smoking abstinence expectancies, nicotine withdrawal, and cigarette dependence among daily smokers. *Journal of Addictive Diseases*, *37*(1–2), 55–63. <https://doi.org/10.1080/10550887.2018.1542239>
- Swann, A. C., Steinberg, J. L., Lijffijt, M., & Moeller, F. G. (2008). Impulsivity: Differential relationship to depression and mania in bipolar disorder. *Journal of Affective Disorders*, *106*(3), 241–248. <https://doi.org/10.1016/j.jad.2007.07.011>
- 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>
- Taylor, S. B., Anglin, J. M., Paode, P. R., Riggert, A. G., Olive, M. F., & Conrad, C. D. (2014). Chronic stress may facilitate the recruitment of habit- and addiction-related neurocircuitries through neuronal restructuring of the striatum. *Neuroscience*, *280*, 231. <https://doi.org/10.1016/J.NEUROSCIENCE.2014.09.029>
- Taylor, S., Zvolensky, M. J., Cox, B. J., Deacon, B., Heimberg, R. G., Ledley, D. R., Abramowitz, J. S., Holaway, R. M., Sandin, B., Stewart, S. H., Coles, M., Eng, W., Daly, E. S., Arrindell, W. A., Bouvard, M., & Cardenas, S. J. (2007). Robust dimensions of anxiety sensitivity: development and initial validation of the Anxiety Sensitivity Index-3. *Psychological Assessment*, *19*(2), 176–188. <https://doi.org/10.1037/1040-3590.19.2.176>

- Terracciano, A., Löckenhoff, C. E., Crum, R. M., Bienvenu, O. J., & Costa, P. T. (2008). Five-factor model personality profiles of drug users. *BMC Psychiatry*, *8*.
<https://doi.org/10.1186/1471-244X-8-22>
- Thornton, L. K., Baker, A. L., Lewin, T. J., Kay-Lambkin, F. J., Kavanagh, D., Richmond, R., Kelly, B., & Johnson, M. P. (2012). Reasons for substance use among people with mental disorders. *Addictive Behaviors*, *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. *Frontiers in Psychiatry*, *8*(SEP), 183.
<https://doi.org/10.3389/fpsy.2017.00183>
- Thurn, D., Riedner, A., & Wolstein, J. (2020). Use Motives of Patients with Amphetamine-Type Stimulants Use Disorder and Attention-Deficit/Hyperactivity Disorder. *European Addiction Research*, *26*, 254–262.
<https://doi.org/10.1159/000508871>
- Trull, T. J., Wycoff, A. M., Lane, S. P., Carpenter, R. W., & Brown, W. C. (2016). Cannabis and alcohol use, affect and impulsivity in psychiatric out-patients' daily lives. *Addiction*, *111*(11), 2052–2059. <https://doi.org/10.1111/add.13471>
- Valente, P. K., Bazzi, A. R., Childs, E., Salhaney, P., Earlywine, J., Olson, J., Biancarelli, D. L., Marshall, B. D. L., & 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. *International Journal of Drug Policy*, *85*, 102934.
<https://doi.org/10.1016/j.drugpo.2020.102934>
- Van de Schoot, R., Kaplan, D., Denissen, J., Asendorpf, J. B., Neyer, F. J., & van Aken, M. A. G. (2014). A Gentle Introduction to Bayesian Analysis: Applications to Developmental Research. *Child Development*, *85*(3), 842–860.
<https://doi.org/10.1111/cdev.12169>
- Vassileva, J., & Conrod, P. J. (2019). Impulsivities and addictions: a multidimensional integrative framework informing assessment and interventions for substance use disorders. *Philosophical Transactions of the Royal Society B: Biological Sciences*, *374*(1766), 20180137. <https://doi.org/10.1098/rstb.2018.0137>
- Vehtari, A., Gelman, A., & Gabry, J. (2015). Practical Bayesian model evaluation using leave-one-out cross-validation and WAIC. *Statistics and Computing*, *27*(5), 1413–1432. <https://doi.org/10.1007/s11222-016-9696-4>
- Villarosa-Hurlocker, M. C., Bravo, A. J., Pearson, M. R., Prince, M. A., Madson, M. B., Henson, J. M., Looby, A., Gonzalez, V. M., Henslee, A. M., Cuttler, C., Wong, M. 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: Clinical and Experimental Research*, *43*(4), 732–740. <https://doi.org/10.1111/acer.13966>

- Volkow, N. D., Jones, E. B., Einstein, E. B., & Wargo, E. M. (2019). Prevention and Treatment of Opioid Misuse and Addiction: A Review. *JAMA Psychiatry*, *76*(2), 208–216. <https://doi.org/10.1001/JAMAPSYCHIATRY.2018.3126>
- Volkow, N. D., Koob, G. F., & McLellan, A. T. (2016). Neurobiologic Advances from the Brain Disease Model of Addiction. *New England Journal of Medicine*, *374*(4), 363–371. <https://doi.org/10.1056/nejmra1511480>
- Votaw, V. R., Geyer, R., Rieselbach, M. M., & McHugh, R. K. (2019). The epidemiology of benzodiazepine misuse: A systematic review. In *Drug and Alcohol Dependence* (Vol. 200, pp. 95–114). Elsevier Ireland Ltd. <https://doi.org/10.1016/j.drugalcdep.2019.02.033>
- Votaw, V. R., McHugh, R. K., Vowles, K. E., & Witkiewitz, K. (2020). Patterns of Polysubstance Use among Adults with Tranquilizer Misuse. *Substance Use & Misuse*, *55*(6), 861–870. <https://doi.org/10.1080/10826084.2019.1708118>
- Votaw, V. R., McHugh, R. K., & Witkiewitz, K. (2019). Alcohol use disorder and motives for prescription opioid misuse: A latent class analysis. *Substance Use & Misuse*, *54*(9), 1–11. <https://doi.org/10.1080/10826084.2019.1594904>
- Wagner, M. K. (2001). Behavioral characteristics related to substance abuse and risk-taking, sensation-seeking, anxiety sensitivity, and self reinforcement. *Addictive Behaviors*, *26*(1), 115–120. [https://doi.org/10.1016/S0306-4603\(00\)00071-X](https://doi.org/10.1016/S0306-4603(00)00071-X)
- Wallner, M., & Olsen, R. W. (2008). Physiology and pharmacology of alcohol: the imidazobenzodiazepine alcohol antagonist site on subtypes of GABAA receptors as an opportunity for drug development? *British Journal of Pharmacology*, *154*(2), 288. <https://doi.org/10.1038/BJP.2008.32>
- Wang, J., Wang, P., Yang, X., Zhang, G., Wang, X. C., Zhao, F., Zhao, M., & Lei, L. (2019). Fear of Missing Out and Procrastination as Mediators Between Sensation Seeking and Adolescent Smartphone Addiction. *International Journal of Mental Health and Addiction*, *17*(4), 1049–1062. <https://doi.org/10.1007/s11469-019-00106-0>
- Webster, L. R. (2013). Methadone side effects: Constipation, respiratory depression, sedation, sleep-disordered breathing, and the endocrine system. In *Handbook of Methadone Prescribing and Buprenorphine Therapy* (pp. 39–49). Springer. https://doi.org/10.1007/978-1-4614-6974-2_4/TABLES/5
- Webster, L. R., Cochella, S., Dasgupta, N., Fakata, K. L., Fine, P. G., Fishman, S. M., Grey, T., Johnson, E. M., Lee, L. K., Passik, S. D., Peppin, J., Porucznik, C. A., Ray, A., Schnoll, S. H., Stieg, R. L., & Wakeland, W. (2011). An analysis of the root causes for opioid-related overdose deaths in the United States. *Pain Medicine (Malden, Mass.)*, *12* Suppl 2(SUPPL. 2). <https://doi.org/10.1111/J.1526-4637.2011.01134.X>
- Wesson, D. R., & Ling, W. (2003). The clinical opiate withdrawal scale (COWS). *Journal of Psychoactive Drugs*, *35*(2), 253–259. <https://doi.org/10.1080/02791072.2003.10400007>

- West, R., & Brown, J. (2013). *Theory of Addiction* (Second Edi). Wiley Blackwell.
https://is.muni.cz/el/1423/jaro2017/PSY109/um/68207459/Robert_West__Jamie_Brown_Theory_of_Addiction.pdf
- Whelan, P., & Remski, K. (2012). Buprenorphine vs methadone treatment: A review of evidence in both developed and developing worlds. *Journal of Neurosciences in Rural Practice*, 3(1), 45. <https://doi.org/10.4103/0976-3147.91934>
- White, J. M. (2004). Pleasure into pain: The consequences of long-term opioid use. *Addictive Behaviors*, 29(7), 1311–1324.
<https://doi.org/10.1016/j.addbeh.2004.06.007>
- White, J. M., & Irvine, R. J. (1999). Mechanisms of fatal opioid overdose. *Addiction*, 94(7), 961–972. <https://doi.org/10.1046/J.1360-0443.1999.9479612.X>
- White, W. L., Campbell, M. D., Spencer, R. D., Hoffman, H. A., Crissman, B., & DuPont, R. L. (2014). Patterns of Abstinence or Continued Drug Use Among Methadone Maintenance Patients and Their Relation to Treatment Retention. *Journal of Psychoactive Drugs*, 46(2), 114–122.
<https://doi.org/10.1080/02791072.2014.901587>
- Whiteside, S. P., & Lynam, D. R. (2001). The Five Factor Model and impulsivity: using a structural model of personality to understand impulsivity. *Personality and Individual Differences*, 30(4), 669–689. [https://doi.org/10.1016/S0191-8869\(00\)00064-7](https://doi.org/10.1016/S0191-8869(00)00064-7)
- Windle, R. C., & Windle, M. (2018). Adolescent precursors of young adult drinking motives. *Addictive Behaviors*, 82, 151–157.
<https://doi.org/10.1016/J.ADDBEH.2018.03.002>
- Winstanley, C. A., Olausson, P., Taylor, J. R., & Jentsch, J. D. (2010). Insight into the relationship between impulsivity and substance abuse from studies using animal models. In *Alcoholism: Clinical and Experimental Research* (Vol. 34, Issue 8, pp. 1306–1318). NIH Public Access. <https://doi.org/10.1111/j.1530-0277.2010.01215.x>
- Wiss, D. A. (2019). A biopsychosocial overview of the opioid crisis: Considering nutrition and gastrointestinal health. *Frontiers in Public Health*, 7(JUL), 193.
<https://doi.org/10.3389/FPUBH.2019.00193/BIBTEX>
- Woicik, P. A., Stewart, S. H., Pihl, R. O., & Conrod, P. J. (2009). The substance use risk profile scale: A scale measuring traits linked to reinforcement-specific substance use profiles. *Addictive Behaviors*, 34(12), 1042–1055.
<https://doi.org/https://doi.org/10.1016/j.addbeh.2009.07.001>
- 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>

- Wong, C. C. Y., & Schumann, G. (2008). Genetics of addictions: Strategies for addressing heterogeneity and polygenicity of substance use disorders. *Philosophical Transactions of the Royal Society B: Biological Sciences*, 363(1507), 3213–3222. <https://doi.org/10.1098/rstb.2008.0104>
- Wong, M., Krajisnik, A., Truong, L., Lisha, N. E., Trujillo, M., Greenberg, J. B., Kahler, C. W., Zvolensky, M. J., & Leventhal, A. M. (2013). Anxiety sensitivity as a predictor of acute subjective effects of smoking. *Nicotine and Tobacco Research*, 15(6), 1084–1090. <https://doi.org/10.1093/ntr/nts208>
- World Health Organization. (2009). *Clinical Guidelines for Withdrawal Management and Treatment of Drug Dependence in Closed Settings: Methadone maintenance treatment*. World Health Organization. <https://www.ncbi.nlm.nih.gov/books/NBK310658/?report=reader>
- Wright, K. D., Lebell, M. A. N. A., & Carleton, R. N. (2016). Intolerance of uncertainty, anxiety sensitivity, health anxiety, and anxiety disorder symptoms in youth. *Journal of Anxiety Disorders*, 41, 35–42. <https://doi.org/10.1016/J.JANXDIS.2016.04.011>
- Yaribeygi, H., Panahi, Y., Sahraei, H., Johnston, T. P., & Sahebkar, A. (2017). The impact of stress on body function: A review. *EXCLI Journal*, 16, 1057. <https://doi.org/10.17179/EXCLI2017-480>
- Young, M. A., Fogg, L. F., Scheftner, W., Fawcett, J., Akiskal, H., & Maser, J. (1996). Stable trait components of hopelessness: Baseline and sensitivity to depression. In *Journal of Abnormal Psychology* (Vol. 105, Issue 2, pp. 155–165). American Psychological Association. <https://doi.org/10.1037/0021-843X.105.2.155>
- Zanis, D. A., McLellan, A. T., & Randall, M. (1994). Can you trust patient self-reports of drug use during treatment? *Drug and Alcohol Dependence*, 35(2), 127–132. [https://doi.org/10.1016/0376-8716\(94\)90119-8](https://doi.org/10.1016/0376-8716(94)90119-8)
- Zautra, A. J. (2003). *Emotions, stress, and health*. Oxford University Press.
- Zielinski, L., Bhatt, M., Sanger, N., Plater, C., Worster, A., Varenbut, M., Daiter, J., Pare, G., Marsh, D. C., Desai, D., MacKillop, J., Steiner, M., McDermid Vaz, S., Thabane, L., & Samaan, Z. (2017). *Association between cannabis use and methadone maintenance treatment outcomes: an investigation into sex differences*. 8(1). <https://pubmed.ncbi.nlm.nih.gov/28367308/>
- Zorrilla, E. P., & Koob, G. F. (2019). Impulsivity derived from the dark side: Neurocircuits that contribute to negative urgency. In *Frontiers in Behavioral Neuroscience* (Vol. 13, p. 136). Frontiers Media S.A. <https://doi.org/10.3389/fnbeh.2019.00136>
- Zuckerman, M. (1971). Dimensions of sensation seeking. *Journal of Consulting and Clinical Psychology*, 36(1), 45–52. <https://doi.org/10.1037/h0030478>
- Zuckerman, M. (2007). Sensation seeking and risky behavior. In *Sensation seeking and risky behavior*. American Psychological Association. <https://doi.org/10.1037/11555-000>

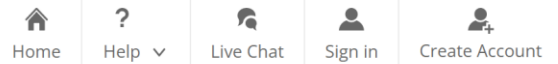
- Zuckerman, M., Ball, S., & Black, J. (1990). Influences of sensation seeking, gender, risk appraisal, and situational motivation on smoking. *Addictive Behaviors, 15*(3), 209–220. [https://doi.org/10.1016/0306-4603\(90\)90064-5](https://doi.org/10.1016/0306-4603(90)90064-5)
- Zuckerman, M., Kolin, E. A., Price, L., & Zoob, I. (1964). Development of a sensation-seeking scale. *Journal of Consulting Psychology, 28*(6), 477–482. <https://doi.org/10.1037/H0040995>
- Zvolensky, M. J., Farris, S. G., Guillot, C. R., & Leventhal, A. M. (2014). Anxiety sensitivity as an amplifier of subjective and behavioral tobacco abstinence effects. *Drug and Alcohol Dependence, 142*, 224–230. <https://doi.org/10.1016/j.drugalcdep.2014.06.023>
- 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. *Addictive Behaviors, 32*(12), 3122–3130. <https://doi.org/10.1016/J.ADDBEH.2007.06.010>
- Zvolensky, M. J., Vujanovic, A. A., Bernstein, A., & Leyro, T. (2010). Distress Tolerance: Theory, Measurement, and Relations to Psychopathology. *https://Doi.Org/10.1177/0963721410388642, 19*(6), 406–410. <https://doi.org/10.1177/0963721410388642>

APPENDIX A. COPYRIGHT PERMISSION TO INCLUDE STUDY 1

Elsevier allows authors to include their articles in full or in part in their thesis for non-commercial purposes.

See: <https://www.elsevier.com/about/policies/copyright/permissions>.

Article DOI: <https://doi.org/10.1016/j.addbeh.2019.106056>



Specificity of personality relationships to particular forms of concurrent substance use among methadone maintenance therapy clients

Author:

I.T. Mahu, P.J. Conrod, S.P. Barrett, A. Sako, J. Swansburg, M. Lawrence, F. Laroque, J.F. Morin, A. Chinneck, R. Nogueira-Arjona, S.H. Stewart

Publication: Addictive Behaviors

Publisher: Elsevier

Date: November 2019

© 2019 Elsevier Ltd. All rights reserved.

Journal Author Rights

Please note that, as the author of this Elsevier article, you retain the right to include it in a thesis or dissertation, provided it is not published commercially. Permission is not required, but please ensure that you reference the journal as the original source. For more information on this and on your other retained rights, please visit: <https://www.elsevier.com/about/our-business/policies/copyright#Author-rights>

BACK

CLOSE WINDOW

APPENDIX B. DEMOGRAPHIC QUESTIONNAIRE

Demographic Information

Subject ID: _____ Researcher ID _____ Date: _____ (dd/MMM/yy)
Time: _____ (hh/mm)

Gender: M / F Age: _____ year Occupation: _____

1. Which group do you most identify with?

- Aboriginal/First Nations
- Black, Afro-Canadian or Caribbean-Canadian
- South Asian (ex., Vietnam, Cambodia, Malaysia, Laos, etc)
- Middle Eastern (ex., Iran, Iraq, Israel)
- Arab-Maghreb (ex., Algeria, Libya, Morocco)
- White (Caucasian) (of European decent)
- Latino
- Asian (China, Korea, Japan)
- Other: _____

2. What is your highest level of education completed? (Select only one)

- No schooling completed
- Elementary School
- Junior High School
- High School
- Trade School
- Community School
- Some University/College
- University/College degree
- Other

3. What is your relationship status?

- Single (never married)
- Married/Cohabiting
- Separated/Divorced
- Widowed

4. What is your current living status?

- Renting
- Own your own home
- living with friends (not paying rent)
- living with family (not paying rent)
- living in community shelter/transitional housing
- living on streets
- Other: _____

5. What is your annual personal/family income?

- \$0 to \$10,000
- \$10,001-\$20,000
- \$20,001-\$29,000
- \$29,001-\$30,000
- \$49,001-\$50,000
- \$50,001-\$59,000
- \$59,001-\$60,000
- \$60,001-69,000

____ \$30,001-\$39,000
____ \$39,001-\$40,000
____ \$40,001- \$49,000

____ \$69,001-\$70,000
____ \$70,001-\$79,000
____ \$79,001 +

6. Have you attended this clinic for the last 30 days, daily, as a witnessed ingestion client? ____ Yes/ ____ No

7. Have you been involved in any activity involving the law (i.e., criminal activity?)
____ recently (in the past 6 months)
____ in the past
____ No

If so, any resulting charges? _____

8. Have you been involved in prostitution?
____ recently (in the past 6 months)
____ in the past
____ No

APPENDIX C. SUBSTANCE USE RISK PROFILE SCALE (SURPS)

Please indicate the extent to which you agree with the following statements by circling the appropriate response statement using the following scale:

	Strongly Disagree	Disagree	Agree	Strongly Agree
1. I am content.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
2. I often don't think things through before I speak.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
3. I would like to skydive.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
4. I am happy.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
5. I often involve myself in situations that I later regret being involved in.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
6. I enjoy new and exciting experiences even if they are unconventional	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
7. I have faith that my future holds great promise.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
8. It's frightening to feel dizzy or faint.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
9. I like doing things that frighten me a little.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
10. It frightens me when I feel my heart beat change.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
11. I usually act without stopping to think.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
12. I would like to learn how to drive a motorcycle.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
13. I feel proud of my accomplishments.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
14. I get scared when I'm too nervous.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
15. Generally, I am an impulsive person.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
16. I am interested in experience for its own sake even if it is illegal.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
17. I feel that I'm a failure.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
18. I get scared when I experience unusual body sensations.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

19. I would enjoy hiking long distances in wild and uninhabited territory.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
20. I feel pleasant.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
21. It scares me when I'm unable to focus on a task.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
22. I feel I have to be manipulative to get what I want.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
23. I am very enthusiastic about my future.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

Scoring: HOP = items 1, 4, 7, 13, 17, 20, 23 (all reverse scored except item 17). IMP =

items 2, 5, 11, 15, 22. SS = Items 3, 6, 9, 12, 16, 19. AS = Items 8, 10, 14, 18, 21.

APPENDIX D. SUBSTANCE USE QUESTIONNAIRE

Methadone Questions

What is your current dose?

How many days in the past 30 days have you taken Methadone?

Have you ever been on Methadone before?

Yes _____

No _____

How many previous programs or times prescribed?

What is your current status at D180? (i.e. carry or observed)

How long have you been a client at D180 (this time)?

of days: _____

If carries, specify length of time (days):

of days: _____

Substance Note: Circle drug they report using most frequently when there is a list of drugs, or write it down if it's not on the list. Prompt: <i>Which do you use most frequently?</i>	Have you ever used in your lifetime? (check applicable substance)	Have you ever used daily or nearly daily, in your lifetime?	Max # of days in a 30-day period that you have used it? (i.e., daily for a week? daily for 30 days?)	Have you used this drug in the...		How many days in the past 30 have you used?	Have you craved in the past 30 days and if so, how many days have you craved?	In the past 30 days how have you used? 1=Used as prescribed 2=Prescribed but misused 3= without prescription	In the past 30 days what is the route of admin 1=smoked/inhaled 2=snorted 3=injected 4=oral 5=other	If injected, on how many days in the past 30 days?	In the past 30 days, did you use this drug with any other drugs or alcohol? Circle Can = cannabis, Alc = Alcohol, Tob = Tobacco
				Past 12 months?	Past 30 days? *						
Alcohol									1 2 3 4 5		Can Alc Tob Oth_____
Tobacco									1 2 3 4 5		Can Alc Tob Oth_____
Marijuana (weed, pot)								1 2 3	1 2 3 4 5		Can Alc Tob Oth_____
Hallucinogens (LSD, Mescaline, shrooms)									1 2 3 4 5		Can Alc Tob Oth_____
Ecstasy (MDMA, Molly)									1 2 3 4 5		Can Alc Tob Oth_____
Kiaran									1 2 3 4 5		Can Alc Tob Oth_____
Powdered Cocaine									1 2 3 4 5		Can Alc Tob Oth_____
Crack									1 2 3 4 5		Can Alc Tob Oth_____
Other Stimulants (Methamphetamine, Speed, Crystal Meth, Ice)									1 2 3 4 5		Can Alc Tob Oth_____

Prescription Stimulants (Adderall, Concerta, Dexedrine, Methylphenidate, Ritalin) _____								1 2 3	1 2 3 4 5		Can Alc Tob Oth _____
Heroin									1 2 3 4 5		Can Alc Tob Oth _____
Prescription Opiates (Pain Relievers: (Codeine, Dilaudid, Demerol, Fentanyl, Morphine, OxyContin Percocet, Vicodin) _____								1 2 3	1 2 3 4 5		Can Alc Tob Oth _____
Prescription Tranquilizers/Sedative (Ativan, Clonazepam, Pentobarbital, Valium) _____								1 2 3	1 2 3 4 5		Can Alc Tob Oth _____
Quetiapine fumarate (Seroquel)								1 2 3	1 2 3 4 5		Can Alc Tob Oth _____

***If usage reported in the past 30 days, administer motives questionnaire for each drug, including alcohol and tobacco**

NSHA 1020164 Version 3 January 28, 2016

APPENDIX E. COPYRIGHT PERMISSION TO INCLUDE STUDY 2

Study 2A was published in Open Access form under an Attribution-Non Commercial-No Derivatives 4.0 International (CC BY-NC-ND 4.0) licence, therefore granting permission to copy and redistribute the material in any medium with proper acknowledgment for non commercial purposes. Elsevier states that authors can include their articles in full or in part in a thesis or dissertation for non commercial purposes.

Article DOI: [10.1016/j.drugalcdep.2021.109133](https://doi.org/10.1016/j.drugalcdep.2021.109133)

Home? Help ▾Live ChatSign inCreate Account



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

Author: Ioan T. Mahu, Sean P. Barrett, Patricia J. Conrod, Sara J. Bartel, Sherry H. Stewart

Publication: Drug and Alcohol Dependence

Publisher: Elsevier

Date: 1 December 2021

© 2021 The Authors. Published by Elsevier B.V.

Journal Author Rights

Please note that, as the author of this Elsevier article, you retain the right to include it in a thesis or dissertation, provided it is not published commercially. Permission is not required, but please ensure that you reference the journal as the original source. For more information on this and on your other retained rights, please visit: <https://www.elsevier.com/about/our-business/policies/copyright#Author-rights>

BACK

CLOSE WINDOW

APPENDIX F. MOTIVES FOR USE QUESTIONNAIRE

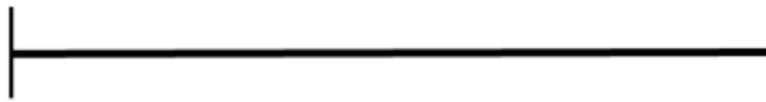
Subject ID _____

Name of substance _____

Researcher ID _____

We would like to have a better understanding of why you use certain drugs. Please draw a vertical line (|) or an “x” for each motive, representing the extent to which you use the drug for that reason.

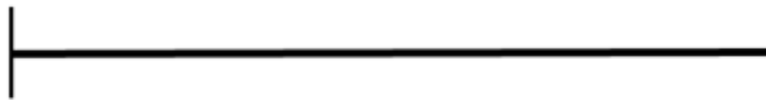
1. In the past 30 days, I've used this drug because it enhances my pleasure (*e.g., because it's exciting or to get a high/buzz*).



NEVER

ALWAYS

2. In the past 30 days, I've used this drug because it's a good way to socialize with others (*e.g., to be sociable or because it makes social gatherings more fun*).



NEVER

ALWAYS

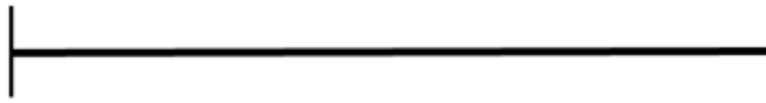
3. In the past 30 days, I've used this drug because it expands my awareness (*e.g., allows me to be more creative and original or understand things differently*).



NEVER

ALWAYS

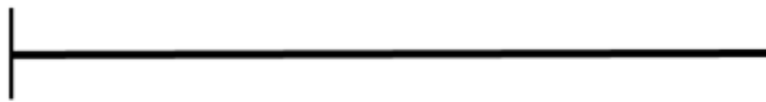
4. In the past 30 days, I've used this drug because it helps me cope when I'm feeling nervous, anxious or tense (e.g., to reduce my anxiety or because I feel more confident or sure of myself).



NEVER

ALWAYS

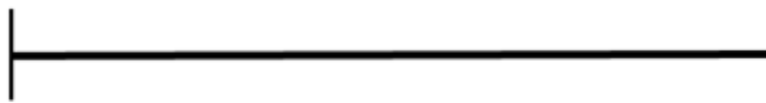
5. In the past 30 days, I've used this drug because it helps me cope when I'm feeling sad, down or blue (e.g., because it helps me when I'm feeling depressed or to numb my pain).



NEVER

ALWAYS

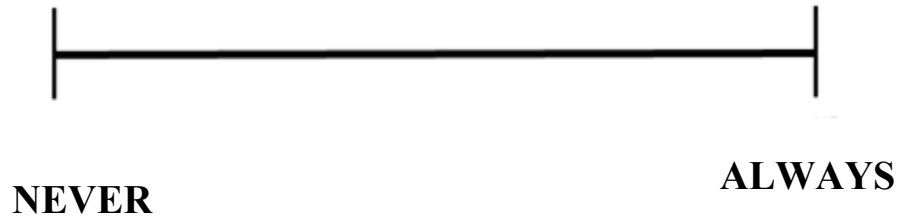
6. In the past 30 days, I've used this drug because I didn't want to feel left out (e.g., because my friends pressure me to use or to fit in with my group).



NEVER

ALWAYS

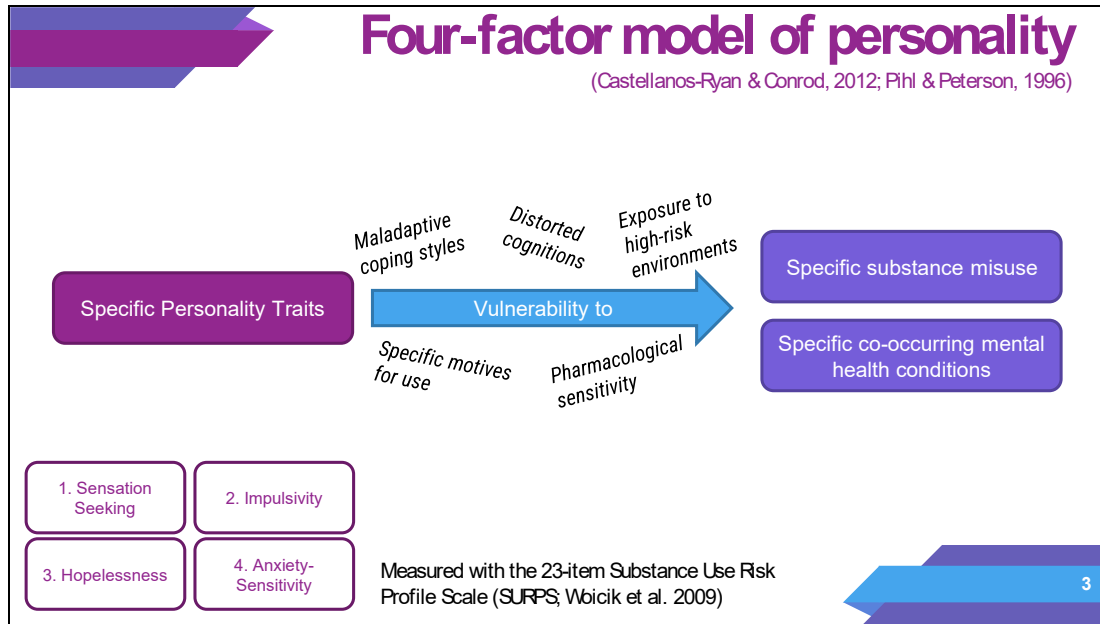
7. In the past 30 days, I've used this drug because it helps me cope with **withdrawal** (e.g., to avoid withdrawal from this drug or to help with withdrawal from another drug).





Brief Overview & Learning Points

1. What is **personality-targeted treatment**?
2. Is it relevant in the **methadone maintenance therapy (MMT) setting**?
3. **Methods: a qualitative study**
4. **Results: practitioners & clients**
5. **Future Directions: manual development**



Personality-Targeted Treatment

(e.g. the "Preventure" intervention)

Personality-Targeted Treatment is designed to target **personality specific cognitive distortions** and teach **adaptive coping skills** so that the individual may employ more effective coping strategies when facing adversity and stress.

- Motivation Enhancement Therapy (MET) + Cognitive Behavioural Therapy (CBT)
- Manualised, evidence-based
- Administered in group (one intervention for each personality type)

```
graph LR; subgraph S1 [Session 1 (90 min)]; direction TB; G[Goal Setting]; P[Psychoeducation on personality trait & risky ways of coping]; end; S1 --- H[1-2 weeks]; subgraph S2 [Session 2 (90 min)]; direction TB; C[CBT exercise homework]; D[Personality-Specific Cognitive Distortions]; L[Learning Adaptive Coping Styles]; end; S2 --> O((Substance Use & Comorbid Mental Health Symptoms In teens)); O --- ME((Mean effect: 0.3));
```

Substance Use & Comorbid Mental Health Symptoms In teens

Mean effect: 0.3

4

(Conrod, Castellanos-Ryan, & Mackie, 2011; Castellanos & Conrod, 2006; Conrod, Stewart, Comeau, & Maclean, 2006; Conrod et al., 2000; Mahu, Doucet, O'Leary-Barrett, & Conrod, 2015; Olthuis, Watt, Mackinnon, & Stewart, 2015; Watt, Stewart, Conrod, & Schmidt, 2008)



Can we develop a brief personality-targeted treatment as an adjunct to MMT?

Is it there interest among practitioners? Is it feasible?
What outcomes would they want to see?

Are MMT clients interested in this type of group?

How do we adapt the treatment and the manuals to a new population?

1. The four factor personality model is associated with concurrent substance misuse among MMT clients (Mahu et al., 2019)
 - Hopelessness -> Opioids
 - Anxiety-Sensitivity -> Tranquilizers
 - Sensation Seeking -> Alcohol, Cannabis, Stimulants
2. Supplementing MMT with psychosocial treatment resulted in (review by Dugost et al., 2016):
 - **greater treatment attendance,**
 - **improved psychological functioning,**
 - **increased adherence to psychiatric medications**
 - **decreased opioid & alcohol use,**
 - **decreased HIV risk,**
 - **decreased detoxification fears.**




7

Qualitative Methods (Thematic Analysis)


Personality-targeted adaptation methodology based on Barrett et al. (2013)'s adaptation of Preventure for Australia

4x Focus Groups with MMT clinics
(MMT treatment providers: case managers, nurses, social workers, physicians, psychiatrists)

Montreal




Halifax




- Feasibility & Barriers
- Client eligibility
- Manual adaptations
- Treatment Structure adaptations

Qualitative Interviews with 19 MMT clients scoring high on one of the four personality traits.
12 males, 7 females



- Collected personality-specific scenarios
- Language
- Manual adaptations
- Treatment structure

8



MMT Treatment Providers Feedback: themes

Feasibility & Logistics	Manualised Format	Treatment Adaptations
<ul style="list-style-type: none">○ Human resources & room limitations○ Partnering with other institutions○ Support in implementation & delivery○ Most thought clients would participate with incentives	<ul style="list-style-type: none">○ Literacy concerns○ Adapting stories & visuals to be culturally & demographically relevant○ Adding specific modules & education (trauma, relapse prevention)	<ul style="list-style-type: none">○ Group vs. Individual○ Number of sessions (more)○ Duration of sessions (shorter)○ Client eligibility based on stage of treatment (i.e. time of intervention)○ Ideal outcomes

9

““ **On desired outcome:**

Education would be a good piece for our population. A lot of our population is entrenched in the drug culture but a lot of times they don't have the education behind it so they don't understand, so maybe sharing some education for future risk prevention. Specifically thinking like **overdose education, using clean needles, stuff like that. Substances, knowing what you are using, treatment options.**

MMT treatment provider, Halifax Focus Group.

Take-away message:

Psychoeducation is a valued outcome for both MMT providers and clients.

““ **On desired outcome:**
It is better quality of life, I don't think abstinence is the goal for these individuals. Just a higher level of understanding of what is happening with their thoughts, their decisions and consequences. I think all of that, you know you look at anxiety and you look at, I think abstinence is what could happen after they know what is happening right. I think a lot of our clients don't know why they do certain things. I think this will help them understand themselves, driving the abstinence anyway.

MMT treatment provider, Halifax Focus Group.

Take-away message:
Abstinence from substances is not necessarily the best outcome to measure efficacy.

11

“ On manualised format:

I mean, these manuals are designed for people that are entrenched already in printed materials and doing work surrounding those. Most of our clients are not doing that and are not involved with working with these materials, generally speaking. The idea of doing that kind of work through print might not be something that people would be all that familiar with or engaged in. There will be variations of the uptake of this kind of model, I think that is the first thing. There are a lot of people who won't relate to this format. **They'll relate to a group which deals with the issues around words (verbally), but printed might be a bit more challenging for a lot of people.**

MMT treatment provider, Halifax Focus Group.

Take-away message:

Important to consider literacy concerns when designing new manuals.

12

“ On logistical difficulties:

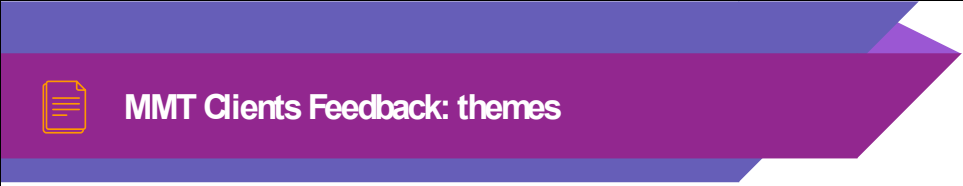
In the past, I've ran a lot of groups, but I find that here, **we don't have enough rooms, we only work from 9-5**. Often, when people organize a group, they have to do it at the end of the day, 6h30 – 8h30, or something like that, but that is not in our schedule.


Original in french: Dans la passé moi j'ai travaillé beaucoup en formule de groupe, mais je trouve que, mais je trouve que ici [redacted], on manque de salles, on manque de salles adéquates, on ne travaille que de 9 à 5. Souvent les gens sont organisés pour participer en groupe, ils ont un travail tout ça donc, y faudrait le faire en fin de journée de 6 h 30 à 8 h 30 des choses comme ça, mais c'est pas dans notre horaire.

MMT treatment provider, Montreal Focus Group.


Take-away message:

Important to budget to free up staff, or solve logistical concerns, when applying for a pilot grant.



 **MMT Clients Feedback: themes**

Interest	Manualised Format	Treatment Adaptations
<ul style="list-style-type: none">○ Most expressed interest in taking part in the intervention.○ Most expressed being comfortable speaking about themselves and substance use in a group setting.	<ul style="list-style-type: none">○ Make visuals more appropriate for an adult population.○ Add more diversity in the characters represented.○ Break text down, have more summaries, more space to write.	<ul style="list-style-type: none">○ Most expressed interest in groups.○ Most advocated adding a module on discussing trauma.○ Session length not longer than 1 hour



14

“ On interest:

Well I think there would be a lot of people that could benefit from it and do a lot of people a lot of good. I know doing stuff like this would do me a lot of good. You know being in some kind of small group or something where you talk about the shit once a week. **That would be a big help for me right now being involved in something like that, but there ain't nothing out there right now** that I can that I know of any... So I mean, it just makes it **really hard to just stay clean** when you don't have good information coming your way. And little programs you can take, like here and stuff.

A105, Impulsivity, male

Take-away message:

There is a need for additional psychosocial services (& education) among this population.

I would like it more, better **for the coping skills**, and things like that because like you said, everybody just said oh you have an addiction, well here try that. **A118, Hopelessness, male**

I would be very interested.
(French: *Moi, je serais très intéressée.*)
C210, Sensation-Seeking, female

15

““ On manual visuals:

But this is, it's not as boring, like this isn't as boring as having to do my step work. This actually has cause this has pictures and stuff so it kinda like **keeps you entertained** and it like **draws your eye to it**, mine's just a plain straight white page with black writing on it and then like dots for each question. It's boring. Like this this could, actually like even if they did this for like step work it would be more less boring to do like it would be more interesting to get into.

A202, Anxiety-Sensitive, female

It's **like the pictures**, or like it actually, like it's something to look at and it's not just like white paper writing and then boringness.

B136, Sensation-Seeking, male

Yeah, that's pretty cool how you guys got this setup. I can see how it would be interesting because of the **visuals are good**.

A105, Impulsivity, male

Take-away message:

Well designed materials can impact interest and motivation to engage in treatment.



Future Directions: creation of scenarios for manuals

Tell me about a time when your [personality trait] got you into trouble...



MMT manual development:
Generate personality-specific stories from the real life experiences of our participants.
Representing all genders, personality profiles, and age groups.





Any questions?

Contact: ioan.tiberiu.mahu@dal.ca (Tib)

Special thanks to:

Dr. Sean P. Barrett
Dr. Sherry H. Stewart
Dr. Patricia Conrod
Dr. Julie Bruneau
Jennifer Swansburg
Aissata Sako
Jean-Francois Morin
Flavie Laroque

&

our numerous MMT
collaborators, clients, and the
small army of transcribers that
helped make this project
happen.



APPENDIX H. DATA COLLECTION PROTOCOL

Numbering of questionnaires:

A = Direction 180 and **B** = CHAMP (Dartmouth clinic)

100 series (Male) **200** series (Female)

Check the Participant ID sheet to determine the participant ID
Quebec

C= Addiction médecine clinic / Clinique externe en toxicomanies

D = Relais méthadone/CRAN Regulier

Participants from Direction 180 will be identified with an A at the beginning of the ID (i.e., A101 would be a male participant from Direction 180, B202 would be female participant from CHAMP, Dartmouth)

Record your Researcher ID on each questionnaire

Nova Scotia Researcher's ID:

Tib Mahu: 01

Leah Jones: 02

Jennifer Swansburg: 03

Kristen Chafe: 04

Craig MacDonald: 05

Parnell Davis MacNevin: 06

Quebec Researcher's ID:

Flavie Laroque: 21

Aïssata Sako: 22

Note the date and time of testing on the page.

1. Overview of the study and the Consent form highlights. A sheet with an overview of the highlights of the consent form can be found in the Researcher package. Review the highlights with the participant and then ask them to review the consent form on their own, read it with them where literacy may be a concern.
2. Have participant complete the **informed consent form**.
3. While participant is completing the consent form, number all questionnaires with the **subject and researcher IDs**.
4. Gather contact information for client, explaining that this is necessary in case they are eligible and interested in Phase 1, Part 2. This information is collected on a separate sheet. Make sure the **participant has not already completed this portion of the survey**.
5. 1st questionnaire: **Demographics Questionnaire** – to be completed by the participant unless assistance by the researcher is required.

6. 2nd questionnaire: **Substance Use Questionnaire** – researcher to complete with the participant
 - a. Page 1: Methadone usage and history
 - b. Complete page 2 of the questionnaire by reading through the substance categories one by one, checking off those substances “Used ever in your lifetime”.
 - c. Then complete the remainder of page 2 of the Substance Use Questionnaire or the substances endorsed under “Used ever in your lifetime” (i.e., if participant answered “yes” to “Used in your lifetime” for only Alcohol, Marijuana, Ecstasy, Prescription Opiates, then ask questions on pages 3 for only these 4 substance categories).

**Ask by substance across categories on the left margin. You can skip certain questions (e.g. if the person has not used in the past 12 months, there is no need to ask if they have used in the past 30 days or to follow up with the more specific 30-days questions).
7. Administer **Motives for Use Visual Analogue scale** for **all substances** identified on page 3 where usage was reported in the past 30 days
8. 3rd questionnaire: **Childhood Trauma Questionnaire (CTQ)**. This questionnaire may create anxiety for some participants whereas some participants express that they experience a negative cost benefit to completing such questionnaires; it allows them the opportunity to share their experience and/or contribute information that may be used in the future to help others and/or bring awareness to the issue relating to traumatic experiences. Remember that participants are free to refuse to complete or answer any questions during this session and still receive full compensation.

If someone refuses to complete the questionnaire, note on the form the reasons that may have been given. Such information will be collected as aggregate information not tracked to the individual.

9. 4th Questionnaire: **Personality questionnaire (SURPS)**. Participant can complete this on their own or with researcher.

Strongly Disagree	Disagree	Agree	Strongly Agree
-------------------	----------	-------	----------------

There is a SURPS answer sheet (shows the following) which participant can use to point to the correct answer for each question

10. **Compensation:** Thank the participant for their time and interest and provide the participant with the reimbursement form asking them to sign, print name and date the reimbursement form. Reimbursement of \$15.00 for Phase 1, Part 1.

11. Inform client that there is a phase 2 and if they are eligible that we will be in touch.

Contact Jennifer: [redacted] or lab: 902-494-3793 with any questions/concerns

APPENDIX I. SEMI-STRUCTURED INTERVIEW GUIDE

[note: the entire interview, including this explanation will be read orally by interviewers]

This is an interview about your personality, your substance use, the settings in which you use drugs, your triggers for drug use and your reasons for drug use. **We are interested in hearing stories about your typical or general drug use habits, but also some specific recent situations when you used drugs, to clarify your moods and reasons for using drugs.** We are particularly interested in hearing about how your personality may sometimes get you into trouble. Following some of the questionnaires you completed, we noticed that you indicated that you *[Read out relevant items from the SURPS; e.g. “That you would really like skydiving” or “that unusual physical sensations scare you”]*. Our goal is to understand how coping with these personality traits influences your drug use behavior.

The interview should not be seen as a “therapy session.” This interview is for research purposes only, and its sole purpose is the collection of data concerning people’s drug use while receiving methadone maintenance treatment to adapt an existing intervention to improve coping skills that is designed for people like you. At the end of the interview we can give you resources on mental health services that you can access at your own discretion. Your responses are fully confidential: However, please keep in mind that we may have to share your information with the proper authorities if you talk about abuse or neglect of a child, an adult in need of protection, plans to commit suicide or planning to harm another person. Other than those exceptions, all of your responses, including you reporting any substance use, will be kept confidential.

This interview will be audiotaped. All information you shared today will be de-identified to protect your confidentiality. This means we will remove any and all identifying information (e.g., names, place names, street names). At the end of the interview you will have the chance to decide whether you want your audio recording to be used for our research purposes or to be deleted.

Initially we will talk a bit about your personality traits and how they may have gotten you in trouble in the past. From there we will move into more specific questions about your experiences with drugs and how you think your personality style shaped those experiences. We are looking for details about what happened before you started using drugs, what happened while you were using drugs, and what happened after, including what you were thinking, feeling, and doing at that time. Please feel free to share as much or as little as you are comfortable with, and to ask me any questions you have as we go along.

Before we begin, do you have any questions? [~2:20 minutes]

Note: at this point, the interviewer will start audio recording the interview and inform the participant of this.

Section 1. Goals & Priorities

Guidelines: We want to know what their priorities, needs & goals are.

Thank you for talking with us today. Before we begin with some of our other questions, we would like to get to know you a little better. Tell us a bit about what your goals and priorities are. Where do you see yourself in the near future? (if only short-term goals offered, prompt for long-term goals *if they have any*)

In respect to your methadone treatment, what are your goals (e.g. do you want to stop using completely, stop using certain substances, or keep things as they are)?

What is the most important thing in your life at the moment? What are your priorities now? What are your needs?

What are some of the major barriers in your life?

Goal Setting & Insight Prompts

General: In general, want to get a sense of their motivations. Start on a positive note and see how they frame their goals.

1. Can you tell me about your goals? What would you like to accomplish or what would you like to change?
2. In terms of your life as a whole, what do you see as the most negative effects or consequences of your drug use? Do you see any positive effects of your drug use?
3. Why is it important for you to receive methadone maintenance therapy?

Section 2. Personality Psychoeducation & Rapport

We are talking to you today because...*[Pinpoint the relevant items on the SURPS subscale that were highly rated, and re-read them to the participant as a reminder].*

Introversion/ Hopelessness Dimension (H)

Item 1
Item 4
Item 7
Item 13
Item 17
Item 20
Item 23

Anxiety Sensitivity Dimension (AS)

Item 8
Item 10
Item 14
Item 18
Item 21

Impulsivity Dimension (IMP)

Item 2
Item 5
Item 11
Item 15
Item 22

Sensation Seeking Dimension (SS)

Item 3
Item 6
Item 9
Item 12
Item 16
Item 19

Use their language whenever possible. Associated emotional vocabulary for use in future prompts:

- H: sad, stressed, depressed, pessimistic
- AS: nervous, tense, anxious, stressed out, overwhelmed, on the edge, unpleasant bodily sensations
- IMP: stressed, angry, frustrated, excited
- SS: bored, “party-time”, “fun”, excited

Do you recognize yourself in some of these statements? They represent a personality trait known as [Negative Thinking/Anxiety-Sensitivity/Sensation-Seeking/Impulsivity]. Everyone has some [name trait] inside of them; some people have more, some have less. For example, I also identify with [pick one item from target subscale that is personally relevant].

Sometimes, these personality traits make us act in certain ways, both good and bad. For instance, people

- [H] With negative thinking tend to see the world more realistically, but may sometimes be more vulnerable to bad events and see things as more negative than they actually are.
- [AS] With Anxiety-sensitivity are generally more careful, but it may sometimes make them feel more uncomfortable, nervous and tense in certain situations.

- **[IMP]** Who are impulsive have an easier time making decisions and going for what they want, but this may lead them to sometimes get angry easier, have things spiral out of control or make poor decisions because they sometimes act without thinking.
- **[SS]** Who are sensation-seekers typically like to live life on the edge, be social and explore, but this can sometimes get them into trouble through doing dangerous activities.

How do you identify with this? Does it describe you well as a person?

What is [negative thinking/anxiety-sensitivity/impulsivity/sensation-seeking] like for you?

What kind of things does [trait] lead you to do?

What kind of things do you do to cope with feeling [AS: stressed out/anxious/nervous/tense; NT: sad/feeling down; SS: bored/on the edge; IMP: angry/on the edge]?

[words] How would you describe [trait]? What words would you use?

That's very interesting, thank you for sharing. Let's talk a bit more about how [trait] may make you act in certain ways.

Section 3. The Situation – Personality & Substance Use

General: You want to obtain information on the situation, the experienced physical sensations, the associated thoughts, and the resulting behavior. Use prompts below as needed. **This is the most important page. Use more than one page if necessary or if several situations are described.** By the end, it should be very clear why they reacted that way; if you still don't understand, you haven't explored the issue enough.

[Situation] Can you tell me more about a situation in which these thoughts/feelings/traits got you into trouble? [Look for details about: **Situation** (who, where, when), **Physical Sensations**, **Triggers**, **Thoughts** (self-talk, cognitive distortions, opinions), **Behaviors** (drug use, risky), **Type of substance use**, **Consequences**]

- **What is the context of the drug using event?** E.g., how do they get drugs, where and when do they use them, who facilitates use?
- **If they don't volunteer a drug use situation, then specifically ask them about illicit drug use.** E.g. "Your [trait] led you to use?", "Tell me more about a situation in which [trait] led you to use".

[Physical Sensations] What did you feel in your body in that situation?

[Thoughts] What kind of thoughts did you have in this situation?

[Action] What did you end up doing? How did you react?

Situation Prompts

General: Need detail about the physical situation but also the larger context and triggers.

1. Where were you at that time?

2. What time of day was it? E.g. do they use in the morning, afternoon or evening?
3. What season?
4. Why were you there? What were you supposed to be doing at the time?
5. How did you get drugs? Who facilitates this?
6. Where did you use?
7. Who else was there?

Physical Sensation Prompts

General: How do they experience the personality trait? Examples include feeling rapid heartbeat, muscle tension, difficult breathing, upset stomach, sweating, trembling, headaches, shaky voice, butterflies in stomach, sweaty palms, agitated, dizzy, feeling sick.

1. What did you feel in that situation?
2. How did it feel inside your body?
3. Do you remember feeling a particular part of your body react?
4. Was your heart racing?
5. Did you notice your hands or shoulders tensing?
6. Did you feel restless?

Personality & Thoughts Prompts

General: pay attention to how personality traits in specific situations seem to trigger substance use and risky behavior.

1. What kinds of thoughts did you have in this situation?
2. [IMP, AS] When you experience conflict or frustration, what do you do? [IMP; Risk] Do you sometimes do dangerous things or things that other people would think are dangerous?
3. [H, AS] When you experience stress, what do you do?
4. [H] When you experience a sad, low, or depressed mood, what do you do?
5. [AS] When you feel nervous, tense, or anxious, what do you do?
6. [SS] When you feel bored, what do you do? [Risk] Do you sometimes do dangerous things or things that other people would think are dangerous?
7. [Coping] Is there anything that you can think of that makes you better cope with [these feelings, thoughts, personality]?
8. [Thoughts] Are you aware of any inner thoughts or emotional feelings, or things within you as a person, which trigger off your need or desire to take the drug at a particular moment in time?
9. [Risk] Would there be any specific feelings or situations that might be more difficult for you to handle?

10. [*Protective*] Can you describe a situation or set of events which would be least likely to result in your feeling like using drugs? In other words, when do you feel least inclined to use drugs?
11. [*Withdrawal*] Suppose that we were to decide that you would not use drugs at all for the next two weeks. What problems do you think you might have if you did this? How do you think it would affect you?

Action/Behaviour Prompts

General: The result of the thought on behavior in that situation.

1. What did you end up doing?
2. How did you react?
3. Is this the reaction you wanted to have?

Substance Related Prompts

General: pay attention to how drugs & their effects are described, polysubstance use, drugs as coping mechanisms.

(prompt if necessary): I see that you've reported using [name the drugs that the participant reported using in their substance use questionnaire]. I would like to know more about how you feel towards [drug(s)], what you like about them, if you have any concerns surrounding them, and the way in which you use [drug].

1. When do you typically use, where, how many times in a day will you use?
2. Which drugs do you think you are most at risk using while on MMT
3. What do you like best about the drug?
4. What do you think influences your drug use? What makes it difficult to stop or to resist?
5. [*Motives*] What are the main reasons why you use drugs? In other words, when you are actually using drugs, what for you is the most positive or desirable effect of the drug for you?
6. When you use (*pick depending on what participant endorses previously*)
 - a. to reduce [AS: anxiety/IMP: stress or boredom/SS: boredom/H: sadness]
 - b. or to [AS: relax/ IMP: cool down, relax or get the party going/ SS: get the party going, H: feel better], what do you do? What happens?
7. So it makes you feel less [*anxious/impulsive/bored/sad*], what do you do next?
8. How does that work for you? Then what do you do?

Self-Efficacy/Treatment response prompts

1. Do you think this is something you can change?
2. [*Concerns*] Can you tell me more about any worries you might have about your drug use?

3. Any workshops available at your clinic already? Are they helpful?

Finish with a brief summary/reflection of the situation at the end to see if the participant offers any corrections.

Thanks so much for your time and for sharing your story with me, I really appreciate it. Is there anything you would like to add?

[Linking with manual] I can understand how you would act that way if you go through this situation. Hopefully, our treatment will be able to address some of these issues and we are hoping to use stories such as yours as examples in our manual.

Space for additional notes:
