Hazardous Drinking Mediates the Relation Between Externalizing Personality and Reduced Adherence to COVID-19 Public Health Guidelines in University Students

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Abstract
Using a multigroup path analysis, we examined if hazardous alcohol use mediated the relations between elevated externalizing personality traits (i.e., impulsivity or sensation seeking) and reduced adherence to COVID-19 public health guidelines. We hypothesized that those high in externalizing personality traits would demonstrate less adherence to public health guidelines and that hazardous alcohol use would mediate this relationship. First- and second-year undergraduates (N = 1232; ages 18–25) from five Canadian universities participated in a cross-sectional survey between January to April 2021. Individuals with higher levels of impulsive or sensation seeking personality traits demonstrated poorer adherence to COVID-19 public health guidelines and these relations were mediated by hazardous alcohol use. Results suggest that hazardous drinking is an important target for students high in impulsivity and sensation seeking to increase their adherence to public health guidelines and thereby help control viral spread.

Keywords
alcohol, adherence, impulsivity, sensation seeking, COVID-19

Introduction
Public health measures (e.g., hand washing, social distancing) have been successful in reducing the spread of COVID-19 (Matrajt & Leung, 2020); however, some people have struggled with or have chosen not to adhere by these guidelines. Two personality traits that may relate to poor adherence are impulsivity and sensation seeking (DeGrace et al., 2021; Frias-Armenta et al., 2021). People high in impulsivity often act without forethought, and struggle to withhold urges and responses, especially in situations of possible immediate reward (Stautz & Cooper, 2013). As such, people high in impulsivity may have more difficulty remembering to engage in hand-washing and mask-wearing (Wismans et al., 2021) and their diminished self-control (Herman et al., 2018) could lead them to seek out spontaneous opportunities for reward, such as joining large gatherings despite potential longer-term consequences (i.e., contracting/spreading COVID-19; Mackinnon et al., 2014; Wismans et al., 2021). In fact, research shows that impulsivity is linked to poor adherence to both COVID-19 public health guidelines, as well as general health practices (e.g., personal hygiene, visiting a doctor Frias-Armenta et al., 2021; Wismans et al., 2021).

As for sensation seeking, individuals crave intense, novel, and exciting experiences, have high stimulation needs, and are

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often considered to be extraverted (Zuckerman, 1994). As such, it may be especially difficult for these individuals to refrain from leaving their homes and to follow social distancing guidelines given that they often become restless and bored by situations that are mundane or repetitive (Lynne-Landsman et al., 2011). Their high level of extraversion may make it difficult for them to resist attending social gatherings. Work by DeGrace and colleagues (2021) found that elevated sensation seeking was related to poorer stay-at-home adherence in adult males.

While research has examined the relations between externalizing traits and poor adherence to COVID-19 health guidelines, little is known about the intermediate factors that contribute to these associations. Previous work has indicated that hazardous alcohol use may be an important factor in externalizing pathways to poor adherence to COVID-19 guidelines. For example, data suggest that emerging adults have reported more frequent and more harmful alcohol use during the pandemic (Coakley et al., 2021; Fendrich et al., 2021; Graupensperger et al., 2021) and their heavier drinking has been shown to contribute to poor adherence to COVID-19 public health guidelines (Einberger et al., 2021). Moreover, Fendrich et al. (2021) found consistent negative associations between heavy drinking and adherence to social distancing and personal hygiene guidelines among adult Americans. These associations between alcohol and poor adherence are likely due to the established disinhibiting effects of alcohol ingestion (Fillmore et al., 2008). This would theoretically interfere with an individual’s ability and/or motivation to adhere to public health measures, which may already be low among those high in externalizing traits. To date, only one study has sought to directly examine whether heavy alcohol use might mediate the associations between externalizing personality traits and poor adherence to COVID-19 public health guidelines. Frias-Armenta et al. (2021) found that impulsivity led to reduced COVID-19 adherence behaviours via heavier alcohol consumption, but effects from sensation seeking were not explored.

The goal of the current study was to contribute to growing evidence linking externalizing traits to COVID-19 adherence by examining the intermediate role of hazardous alcohol use. We hypothesized that individuals with elevated impulsivity and/or sensation seeking would demonstrate poorer adherence to COVID-19 public health guidelines (DeGrace et al., 2021; Wismans et al., 2021) and that these relationships would be mediated by hazardous alcohol use (as defined as a quantity or pattern of alcohol consumption that puts an individual at risk for adverse health effects (Reid et al., 1999). We also hypothesized that this mediational model would be consistent (i.e., invariant) across study sites and across sexes.

The purpose of examining our model across sites was an important extension for three main reasons: (1) prevalence rates of COVID-19, and thus public health measures, have varied significantly across Canada; (2) one site was in a region of Canada that has a different legal drinking age than the other sites; (3) one site was in a region of Canada that requires individuals to complete an additional two to 3 years of school before applying to universities, thereby increasing the age and years of education for individuals in the region. The purpose of examining our model across sex was also an important extension given that studies have found alcohol patterns and adherence to public health guidelines to differ based on sex (DeGrace et al., 2021; Fendrich et al., 2021; Wilsnack et al., 2009).

Materials and Method

Procedure and Participants

The data were collected as part of an ongoing project exploring a personality-matched intervention for mental health problems in first- and second-year university students (ages 18–25). Participants gave informed consent to complete a self-reported survey on REDCap (Research Electronic Data Capture). Data were collected from January to April of 2021. Participants were compensated with a $15.00 Amazon gift card or partial academic credit. A total of 1327 students completed the survey. Ninety-five participants were removed due to large amounts of incomplete data or for failing quality control questions. Of the remaining 1232 students ($M_{age} = 19.2$ years; $SD_{age} = 1.36$), 86% were full-time students, 79% were female, and 67% identified as White.

Measures

Substance Use Risk Profile Scale. The impulsivity (5-items; $\alpha = .69$) and sensation seeking (6-items; $\alpha = .71$) subscales from the Substance Use Risk Profile Scale (SURPS; Woicik et al., 2009) were used for this study (Woicik et al., 2009).

The Alcohol Use Disorder Identification Test-Consumption. The Alcohol Use Disorder Identification Test-Consumption subscale (AUDIT-C; Bush et al., 1998; $\alpha = 0.83$) was used in the current study to capture hazardous drinking behaviour (Campbell & Maisto, 2018).

COVID-19 Adherence Midsummer- Revised. The COVID-19 Adherence Midsummer-Revised (CAM-R; Angus Reid Institute, 2020) was used to assess the extent to which Canadians were following six main public health guidelines for limiting the spread of COVID-19.

Data Analysis

Data were screened and one-way ANOVAs were conducted to examine univariate site differences on externalizing traits, hazardous drinking, and public health adherence. Path modelling was then used to examine hypotheses. Impulsivity and sensation-seeking were specified as correlated predictors; hazardous drinking was specified as the main mediator; and the six COVID-19 public health behaviours were specified as correlated outcomes. Model fit was considered excellent if the
Comparative Fit Index (CFI) was >0.95; the Root Mean Squared Error of Approximation (RMSEA) < 0.06; and the Standardized Root Mean Residual was <0.08 (Hu & Bentler, 1999). We also report the overall model $\chi^2$; however, we placed less emphasis on this measure for determining fit, given its notable limitations in large samples (Kline, 2011).

We then conducted path invariance testing across both study site and biological sex. Differences between nested models were evaluated using the $\Delta \chi^2$ test and the $\Delta$CFI. A substantial difference between models was supported if the $\Delta \chi^2$ test was significant (i.e., $p < .05$) and/or $\Delta$CFI $\geq .01$ (Cheung & Rensvold, 2002). We examined indirect effects using the 95% confidence interval (CI) approach (Fritz & MacKinnon, 2007). Mediation is present if the CI does not cross zero. Finally, for adequate power in path models, there should be at least a 10 case per parameter ratio (Kline, 2011). Our overall path model had 18 estimated parameters, requiring a sample size of $N = 180$, but this value was multiplied by 5 due to the planned multigroup model by study site (i.e., $N = 900$). Our final sample size was much larger than this, and thus, we were adequately powered to test our mediational hypotheses.

**Results**

**Preliminary Analyses**

Statistical Package for the Social Sciences (SPSS; version 28) and Mplus version 8.0 (Muthen & Muthen, 2017) were used to conduct the analyses. All variables showed acceptable skew (<3.0) and kurtosis (<8.0) values (Kline, 2011) and there were no multivariate outliers. There were significant univariate differences between study sites on most measures, likely reflecting regional differences in COVID-19 public health restrictions (e.g., restaurant closures) and their subsequent impact on drinking and other behaviours. These univariate differences suggest that sites differed in the overall means of these variables and also point to the importance of examining how the multivariate associations might differ in the larger
With respect to the AUDIT-C, it has been reported that a score of 5+ for men, and 4+ for women, are the appropriate cut-off scores to identify hazardous alcohol use (Bush et al., 1998). In the current study, there was a considerable range across study sites, however within the total sample, 70% scored above a 5 on the AUDIT-C, suggesting considerable hazardous drinking in the sample.

**Hypothesis Testing: Substantive Path Model with Invariance Testing by Study Site and Sex**

The hypothesized model provided excellent fit to the data ($\chi^2_{(12)} = 20.873, p = .052, CFI = .994, RMSEA = .024, 90% CI [0.000, 0.041]$). As seen in Figure 1, both high sensation seeking and impulsivity predicted elevated hazardous drinking, accounting for 10.2% of the variance. High levels of hazardous drinking predicted poor adherence to all six COVID-19 public health guidelines, accounting for the most variance in outcomes related to not socially distancing and not staying away from public spaces. Follow-up multigroup models showed that the overall model was invariant across both study site and biological sex (see Table 1). Therefore, while we observed univariate differences in most model variables, the complex multivariate associations in the tested path model did not differ by site or by biological sex. Finally, we observed mediational effects from both impulsivity and sensation seeking to all six COVID-19 health guidelines (See Table 2).

**Discussion**

The current study provides several important contributions to the literature. First, we found that greater hazardous alcohol use mediated the effects of externalizing traits on poor adherence to all six COVID-19 public health guidelines, accounting for the most variance in outcomes related to not socially distancing and not staying away from public spaces. Follow-up multigroup models showed that the overall model was invariant across both study site and biological sex (see Table 1). Therefore, while we observed univariate differences in most model variables, the complex multivariate associations in the tested path model did not differ by site or by biological sex. Finally, we observed mediational effects from both impulsivity and sensation seeking to all six COVID-19 health guidelines (See Table 2).

| Table 1. Invariance Testing by Study Site and Biological Sex: Model Fit Information. |
| Model Type | $\chi^2$ | df | $p$ | CFI | RMSEA | SRMR | $\Delta \chi^2$ | df | $p$ | $\Delta$CFI |
| Study site | |
| Overall | 20.873 | 12 | .0523 | .994 | .024 | .019 |
| Site 1 | 10.115 | 12 | .6059 | 1.000 | 0.000 | 0.023 |
| Site 2 | 19.142 | 12 | .0852 | .982 | .040 | .042 |
| Site 3 | 7.771 | 12 | .8028 | 1.000 | 0.025 | 0.025 |
| Site 4 | 15.379 | 12 | .2214 | .992 | .035 | .024 |
| Site 5 | 16.567 | 12 | .1666 | .966 | .056 | .048 |
| Configural | 68.966 | 60 | .2001 | .994 | .025 | .033 |
| Path invariance | 109.300 | 92 | .1053 | .988 | .028 | .052 |

| Biological sex | |
| Overall | 20.873 | 12 | .0523 | .994 | .024 | .019 |
| Male | 22.859 | 12 | .0289 | .970 | .060 | .040 |
| Female | 14.595 | 12 | .2643 | .998 | .015 | .017 |
| Configural | 37.583 | 24 | .0382 | .991 | .030 | .023 |
| Path invariance | 51.188 | 32 | .0171 | .987 | .031 | .034 |

Note. Model cut-offs are as follows: $\chi^2 (p > .05), CFI \geq .95, RMSEA \leq .06, SRMR \leq .08, \Delta \chi^2 (p < .05)$ and $\Delta$CFI < .01.

| Table 2. Estimates and Confidence Intervals for Indirect Pathways from Personality to Nonadherence to COVID-19 Public Health Guidelines via Hazardous Drinking. |
| Indirect Pathway | Standardized Estimate | 95% CI* |
| Sensation seeking $\rightarrow$ hazardous drinking $\rightarrow$ washing hands/sanitizing | .058 | [.038, .079] |
| Sensation seeking $\rightarrow$ hazardous drinking $\rightarrow$ social distancing | .078 | [.054, .102] |
| Sensation seeking $\rightarrow$ hazardous drinking $\rightarrow$ not shaking hands/hugging | .077 | [.053, .100] |
| Sensation seeking $\rightarrow$ hazardous drinking $\rightarrow$ staying away from public spaces | .085 | [.060, .111] |
| Sensation seeking $\rightarrow$ hazardous drinking $\rightarrow$ mask wearing | .051 | [.030, .073] |
| Sensation seeking $\rightarrow$ hazardous drinking $\rightarrow$ keeping up with experts | .041 | [.021, .061] |
| Impulsivity $\rightarrow$ hazardous drinking $\rightarrow$ washing hands/sanitizing | .025 | [.010, .040] |
| Impulsivity $\rightarrow$ hazardous drinking $\rightarrow$ social distancing | .033 | [.014, .053] |
| Impulsivity $\rightarrow$ hazardous drinking $\rightarrow$ not shaking hands/hugging | .033 | [.013, .052] |
| Impulsivity $\rightarrow$ hazardous drinking $\rightarrow$ staying away from public spaces | .036 | [.016, .057] |
| Impulsivity $\rightarrow$ hazardous drinking $\rightarrow$ mask wearing | .022 | [.008, .036] |
| Impulsivity $\rightarrow$ hazardous drinking $\rightarrow$ keeping up with experts | .017 | [.005, .030] |

*Bias-corrected confidence intervals based on 10,000 bootstrapped sample. All indirect effects were support.
adherence to COVID-19 public health guidelines, specifically among emerging adults in Canada. Moreover, we found this relationship to be consistent across the geographical regions we examined (i.e., 4 different provinces) and across biological sex. Additionally, the current study contributes to the literature by examining specific aspects of personality (impulsivity and sensation seeking) and displaying their unique contributions to hazardous alcohol use and adherence.

The current study is not without limitations; much like other studies (Fendrich et al., 2021), the current study had somewhat limited diversity with respect to race and we recognize that pursuing a more racially diverse sample may have significantly improved the study’s generalizability. An additional limitation is our use of a cross-sectional study design. Although many previous studies on this topic were cross-sectional (Frias-Armenta et al., 2021; Taylor & Asmundson, 2021), the use of cross-sectional data impeded our ability to make inferences about directionality. For example, it is possible that hazardous drinking could emerge out of instances of non-adherence in social situations (e.g., attending social gatherings, like parties). There was no good way of testing this reverse model in our cross-sectional data; therefore, future longitudinal studies should aim to disentangle these temporal effects.

In conclusion, the current study found that individuals with higher impulsivity or sensation seeking were more likely to engage in hazardous alcohol use and in turn were less likely to adhere to COVID-19 public health guidelines. Interventions that target hazardous drinking in students high in sensation seeking and impulsivity are recommended in order to increase adherence. Existing interventions, designed for students high in sensation seeking and impulsivity, have been found to reduce hazardous drinking (e.g., PreVenture; Conrod et al., 2007; Newton et al., 2016). As such, future work may seek to examine whether PreVenture increases adherence to public health guidelines. If so, research may wish to examine whether the effects on adherence are mediated through reductions in hazardous drinking.

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Note
1. Given the hypothesized mediation effects, we ran the initial path model without including direct effects from the externalizing traits to the adherence behaviour outcomes. While fit indices suggested excellent fit of this model, we ran a supplementary model including these direct effects. None of these direct effects were statistically significant, which supported full mediation effects through hazardous drinking. Thus, we retained the more parsimonious model (without direct effects) in the current study.

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Natasha Baptist-Mohseni is a graduate student in the Clinical Neuropsychology Program at York University. Her research focuses primarily on understanding executive dysfunction in individuals with comorbid alcohol use disorder and depression. Her clinical interests include working with older adults experiencing cognitive decline, as well as adults with neurodevelopmental disorders.

Naama Kronstein is a graduate student in the Clinical Psychology Program at York University. Her research primarily focuses on understanding vulnerability and protective factors related to substance and behavioural addiction. Her clinical interests include reducing stigma against addiction and mental health, improving upon existing treatments, and developing new treatments for addictions.

Clayton Murphy is a graduate student in Clinical Social Work at the University of British Columbia, Okanagan. Previously, he has completed a Bachelor of Science with
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**Dr. Fakir Yunus** is a Post-doctoral Fellow at Dalhousie University’s Department of Psychology. Yunus is a medical doctor (MBBS) by training from Bangladesh (not registered in Canada). He has over ten years of experience working on a variety of public health projects, during which time he honed his expertise in carrying out Randomized Controlled Trials (RCT) studies. His research interest includes psychology, nutrition, sleep, and concurrent public health issues.

**Dr. Tabatha Thibault** holds an MSc and PhD in Applied Psychology focusing on Industrial/Organizational Psychology. Her research interests include health and safety, workplace dignity, incivility and cyber deviance in the workplace, the Dark Tetrad of personality, and leadership.

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**Dr. Marvin Krank** joined the University of British Columbia, Okanagan campus as Dean of Graduate Studies and Professor of Psychology in 2005. Dr. Krank has an active research program in substance use with an emphasis on adolescents. He has published numerous articles and presents for professional conferences, invited symposia, and community groups. The focus of Dr. Krank’s research is the psychological determinants of drug use and drug effects including seminal work on drug tolerance, drug withdrawal and cognitive models of substance use trajectories in adolescents.

**Dr. Kara Thompson** is an Associate Professor of Psychology at St. Francis Xavier University. Dr. Thompson’s research program focuses on youth substance use and mental health. She approaches her work from a combination of applied, population health, and developmental-contextual perspectives. Her work focuses on understanding how mental health and substance use patterns develop across adolescence and young adulthood, investigating the predictors and consequences of mental health and substance use patterns and informing the development and evaluation of evidence-based policies and interventions to promote health, social responsibility, and healthy substance use patterns among young people.

**Dr. Patricia Conrod** is a Clinical Psychologist and Professor of Psychiatry at Universite de Montreal. Her research team is based at the CHU Sainte-Justine Mother and Child Hospital Centre in Montreal. She was previously a Senior Clinical Lecturer in the Addictions Department, at King's College London (2003-2010). Her research focuses on cognitive, personality and biological risk factors for the development and maintenance of drug abuse and the factors that mediate the co-occurrence of addictive behaviours with other mental disorders. Her research findings have led to the development of new approaches to substance abuse treatment and prevention that target personality risk factors and the underlying motivational determinants of drug use in subtypes of substance misusers. She developed the Preventure Program, which is identified as an evidence-based drug and alcohol prevention program by a number of national registries of evidence-based programs and the U.S. Surgeon General’s Report on Addiction.

**Dr. Sherry Stewart** is a Professor of Psychiatry and Psychology at Dalhousie University and a Tier 1 Canada Research Chair in Addiction and Mental Health. Dr. Stewart studies the role of psychological factors (e.g., personality, motives) in contributing to addictive behaviours including alcohol use, prescription drug misuse, and excessive gambling. She also investigates mechanisms underlying comorbid mental health and addictive disorders. She has conducted several trials of novel approaches for treating and preventing co-occurring mental illness and addictions.

**Dr. Matthew Keough** is an Assistant Professor in the Department of Psychology. He earned a BSc. from the University of Toronto, and an M.A., and Ph.D. from Concordia University. He also completed a CIHR-funded postdoctoral fellowship at the Centre for Addiction and Mental Health. He is a registered clinical psychologist and former Chair of the Addiction Psychology section of the Canadian Psychological Association. He was previously an Assistant Professor in the Department of Psychology at the University of Manitoba (2017 – 2019). His research focuses on improving our understanding of the etiology and treatment of addictive behaviour, including both substance use and behavioural addictions (e.g., problem gambling).