

Emotional Psychopathology and Coping Cannabis Use Motives Are Involved in the Link Between Anxiety Sensitivity and Adverse Cannabis-Related Outcomes in Canadian Emerging Adults

Haley C.R. Bernusky, McKenzie Cline, Pablo Romero-Sanchiz, Philip G. Tibbo, Patricia J. Conrod, Fakir Md. Yunus, Matthew T. Keough, Kara D. Thompson, Marvin D. Krank, Allyson F. Hadwin & Sherry H. Stewart

To cite this article: Haley C.R. Bernusky, McKenzie Cline, Pablo Romero-Sanchiz, Philip G. Tibbo, Patricia J. Conrod, Fakir Md. Yunus, Matthew T. Keough, Kara D. Thompson, Marvin D. Krank, Allyson F. Hadwin & Sherry H. Stewart (2026) Emotional Psychopathology and Coping Cannabis Use Motives Are Involved in the Link Between Anxiety Sensitivity and Adverse Cannabis-Related Outcomes in Canadian Emerging Adults, *Substance Use & Misuse*, 61:5, 655-665, DOI: [10.1080/10826084.2025.2570501](https://doi.org/10.1080/10826084.2025.2570501)

To link to this article: <https://doi.org/10.1080/10826084.2025.2570501>



© 2025 The Author(s). Published with license by Taylor & Francis Group, LLC.



Published online: 02 Nov 2025.



Submit your article to this journal [↗](#)



Article views: 1135



View related articles [↗](#)



View Crossmark data [↗](#)

Emotional Psychopathology and Coping Cannabis Use Motives Are Involved in the Link Between Anxiety Sensitivity and Adverse Cannabis-Related Outcomes in Canadian Emerging Adults

Haley C.R. Bernusky^{a,b} , McKenzie Cline^c, Pablo Romero-Sanchiz^d, Philip G. Tibbo^b, Patricia J. Conrod^e, Fakir Md. Yunus^c, Matthew T. Keough^a, Kara D. Thompson^f, Marvin D. Krank^g, Allyson F. Hadwin^h and Sherry H. Stewart^{b,c}

^aDepartment of Psychology, York University, Toronto, Canada; ^bDepartment of Psychiatry, Dalhousie University, Halifax, Canada; ^cDepartment of Psychology and Neuroscience, Dalhousie University, Halifax, Canada; ^dDepartment of Psychology, University of Sussex, Brighton and Hove, UK; ^eDépartement de psychiatrie et d'addictologie, Université de Montréal, Montréal, Canada; ^fDepartment of Psychology, St Francis Xavier University, Antigonish, Canada; ^gThe University of British Columbia, Vancouver, Canada; ^hDepartment of Psychology, University of Victoria, Victoria, Canada

ABSTRACT

Background: Cannabis use and related problems are prevalent among Canadian emerging adults. Investigating risk factors for cannabis use and related problems, such as personality traits, is important for earlier risk mitigation in this vulnerable population. Anxiety sensitivity (AS) is associated with adverse cannabis outcomes in emerging adults, though the mechanisms driving this effect remain unclear. Theory linking AS to cannabis use and related problems through emotional (i.e., anxiety and/or depression) symptoms and negative reinforcement motivations for use (i.e., coping and conformity) required testing. **Methods:** $N=481$ undergraduates completed online self-report measures. A chained indirect effects path analysis model was run with AS specified as the independent variable, cannabis-related problems and cannabis use frequency as correlated dependent variables, and emotional psychopathology and cannabis use motives as intermediate variables; bias-corrected bootstrapped 95% confidence intervals tested the presence/magnitude of indirect effects. **Results:** Consistent with hypotheses, AS was indirectly associated with both cannabis use frequency and cannabis-related problems through emotional psychopathology and, in turn, coping motives for cannabis use, with no evidence of a remaining direct pathway. Contrary to hypotheses, no indirect effects through conformity motives were observed. **Conclusions:** Results suggest that emerging adults higher in AS are at increased risk for more frequent and problematic cannabis use due to their increased propensity to use cannabis to cope with anxiety and/or depression, implicating both emotional symptoms and coping motives as potential targets for personality-matched cannabis use risk mitigation efforts.

KEYWORDS

anxiety sensitivity; cannabis use; motives; anxiety; depression; coping; conformity; cannabis-related problems; emerging adults; indirect effects

Introduction

Emerging adulthood occurs between ages 18–29 years and is characterized by self-exploration, major life transitions, and increased risk for developing mental health challenges (Arnett et al., 2014). Many emerging adults use cannabis: in 2022, 50% of all 20–24-year-olds in Canada reported past-year cannabis use (Health Canada, 2022). Of these past-year cannabis-using emerging adults, 29% reported daily or almost daily use (Health Canada, 2022). These rates of use are concerning as cannabis use has been linked to emerging adults' risks for developing cannabis-related problems such as cannabis use disorder (Hasin et al., 2019; McGuckin et al., 2021). Approximately 60.3% of those who used cannabis in the past three months reported at least one cannabis-related harm (i.e., social, health, legal, psychological; Health Canada, 2021). While not all emerging adults

will experience harms from their cannabis use, it is important to understand the psychological mechanisms driving adverse cannabis use outcomes in this population. This knowledge may inform education for emerging adults on less risky cannabis use and interventions designed specifically for mitigating emerging adults' vulnerability for developing cannabis-related problems.

Certain personality traits have been associated with risky substance use in general and risky cannabis use and related harms in particular (Comeau et al., 2001; Conrod et al., 2000; Hecimovic et al., 2014). The four-factor personality vulnerability model for risky substance use describes two externalizing traits (e.g., impulsivity and sensation seeking) and two internalizing traits (e.g., hopelessness and anxiety sensitivity [AS]) that place emerging adults at risk for more frequent and/or problematic substance use (Castellanos-Ryan

& Conrod, 2012; Conrod et al., 2000). Among these, AS—defined as the fear of anxiety-related sensations such as a racing heart or rapid breathing (McNally, 2002)—has been associated with past-month cannabis use (Knapp et al., 2021) and cannabis dependence (Johnson et al., 2010). Those higher in AS are also prone to more emotional psychopathology symptoms such as anxiety and depression (McLaughlin et al., 2007; Olatunji & Wolitzky-Taylor, 2009; Taylor et al., 1996). This suggests that higher AS individuals may use cannabis to cope with these emotional symptoms, reinforcing potentially problematic cannabis use patterns (Stewart, 2024).

Cannabis use motives (i.e., reasons for use) known to increase risky patterns of cannabis use (Cooper et al., 2016) are also critical variables to understand. Past research in both adolescent and emerging adult samples suggests that both AS and emotional symptoms are linked to negative reinforcement motives for cannabis use, including coping (i.e., using cannabis to reduce/manage negative emotions) and conformity (i.e., using cannabis to avoid social rejection by others) motives (Comeau et al., 2001; Cooper et al., 2016; Hecimovic et al., 2014; Knapp et al., 2021; Zvolensky et al., 2009). Research has also shown that those higher in AS are likely to use cannabis for negative-reinforcement-based motives due to their fear of situations that may increase their anxiety sensations (Bonn-Miller et al., 2007; Hecimovic et al., 2014; Johnson et al., 2010; Knapp et al., 2021) and due to their beliefs regarding cannabis' ability to quell those feared symptoms (Elsaid et al., 2024; Schafer & Brown, 1991). While the anxiolytic effects of cannabis remain inconclusive in randomized controlled trials (Black et al., 2019; Tibbo et al., 2021), the general public commonly believes that cannabis has anxiety- and stress-reducing properties (Spinella et al., 2021, 2023), and those expectancies may drive coping-motivated cannabis use. Furthermore, for those higher in AS, the threat of social rejection may be distressing as it could provoke the very anxiety-related symptoms they fear (Khakpoor et al., 2019). As such, conformity-motivated cannabis use may serve as a means of avoiding both social rejection and the onset of aversive and feared internal sensations in situations where these sensations may be observable to others.

Theoretically, those higher in AS who experience emotional symptoms and use cannabis for negative reinforcement reasons (i.e., coping/conformity) may consequently be at increased risk of frequent cannabis use and cannabis-related problems given established links between negative reinforcement motives and adverse cannabis outcomes (Simons et al., 1998). For example, emerging adults who use cannabis to cope are more likely to develop physiological symptoms of cannabis dependence relative to those who do not use cannabis to cope (van der Pol et al., 2013). Further, cannabis use for conformity motives has been specifically linked with cannabis-related problems in some studies (Fox et al., 2011; Simons et al., 1998) but not others (Bartel et al., 2023; Buckner et al., 2007). Finally, a recent meta-analysis showed significant associations between these risky negative-reinforcement cannabis use motives and cannabis-related problems (Bresin & Mekawi, 2019).

While evidence exists linking AS to emotional problems (e.g., Olatunji & Wolitzky-Taylor, 2009) and to negative-reinforcement motives for cannabis use (e.g., Hecimovic et al., 2014), AS to adverse cannabis outcomes (e.g., Knapp et al., 2021), and negative-reinforcement motives to adverse cannabis outcomes (Bresin & Mekawi, 2019), only one study to date has directly tested the theorized role of negative reinforcement motives in explaining the link of AS to adverse cannabis outcomes. Johnson et al. (2010) reported that coping motives for cannabis use mediated the positive link between AS and a severe form of cannabis-related problem, namely cannabis dependence, in a small ($N=136$) sample of emerging adults in the US. However, this model did not include broader emotional psychopathology symptoms, nor did it examine a comprehensive set of motives as sequential intermediate variables in the link between AS and emerging adults' cannabis-related problems more broadly; this was the primary objective of this study. In addition, we also sought to evaluate cannabis use frequency as an additional correlated outcome.

In the current study, we extend this prior work by using path analyses to test a chained indirect effects model wherein AS is indirectly associated with two correlated outcomes—cannabis use frequency and cannabis-related problems—through the chained intermediate variables of elevated emotional psychopathology (i.e., symptoms of anxiety and depression) and, in turn, greater endorsement of up to five correlated cannabis use motives—coping, conformity, enhancement, social, and expansion. This approach allowed us to examine the indirect effects of AS on cannabis outcomes through both emotional distress and motivational processes. By accounting for multiple motives and outcomes simultaneously, our model provides a more nuanced understanding of the psychological mechanisms linking AS to risky cannabis use patterns and problems in emerging adults, allowing for a rigorous test of the hypothesized role of negative reinforcement motives specifically. Hypotheses were tested in a large sample of Canadian cannabis-using emerging adult undergraduates. We expected to obtain evidence for indirect associations between AS and both cannabis use frequency and cannabis-related problems through emotional psychopathology symptoms (i.e., anxiety and depression) and, in turn, negative reinforcement cannabis use motives (i.e., both coping and conformity).

Methods

Participants and procedures

The present study involved a secondary data analysis drawn from a cross-sectional, self-reported online survey of undergraduates' mental health, substance use, and academic challenges collected in spring 2021. Survey participants were first- and second-year undergraduates aged 18–25 years. To be eligible for the present study, our subsample had to have reported using cannabis in the past month. The larger survey also served as a screening for a personality-targeted risky substance use prevention pilot project launched across

five Canadian universities (Lambe et al., 2023; Yunus et al., 2022). The survey was not advertised as being for a substance use intervention, nor was it advertised as being for those with elevated AS specifically; thus, the original sample from which our subsample of past month cannabis users was drawn was a general undergraduate sample.

Each study site received research ethics board approval to administer the survey and recruit through various means (e.g., email invitations to complete the survey, sharing posts to student social media groups) in collaboration with several stakeholders, including Student Affairs units and student organizations from the five universities. Participants provided written, electronic informed consent before completing online survey measures and received either partial credit for eligible psychology courses or a modest monetary stipend as compensation. Cross-site data were merged, scored, and cleaned: incomplete responses, along with anyone outside of the age range, and those not in their first two years of study were removed. Anyone who endorsed using a fake drug or who wanted their data destroyed were also removed. The cleaning process produced a final sample of 1,318 participants; details can be found in Yunus et al. (2022) and Lambe et al. (2023). In the present study, we tested hypotheses on the subset (i.e., 36.5%) of the overall sample who reported current (i.e., past month) cannabis use: $n=481$, mean [$\pm$ SD] age = 19.17 [1.24] years; 77.3% female; 48.6% first-year undergraduates. We restricted analyses to those who currently use cannabis, as reporting on cannabis motives required endorsement of recent cannabis use.

Measures

Participants completed an online survey including questionnaires gathering data on demographics (e.g., sex, gender, age, ethnicity, year of study), personality, motives for substance use, substance-related outcomes, mental health, and academic outcomes. While other measures were collected as part of the full UniVenture trial, we describe in greater detail only the measures used in the present study.

Substance use risk profile scale

All survey participants completed the 23-item Substance Use Risk Profile Scale (SURPS; Woicik et al., 2009) consisting of four subscales used to measure participants' levels of sensation seeking, impulsivity, hopelessness, and AS; the latter served as the independent variable in the present study. Participants were asked to indicate their level of agreement with various statements using the response options 1 = *Strongly disagree*, 2 = *Disagree*, 3 = *Agree*, 4 = *Strongly agree*, or *I prefer not to say* (treated as missing). The AS subscale is comprised of five items (sample item: "It's frightening to feel dizzy or faint") for total scores that ranged from 5 to 20, and where higher scores were indicative of greater levels of AS. Prior work supports the strong psychometric properties of the SURPS AS subscale (Woicik et al., 2009). In the

present study, the Cronbach's alpha reliability estimate of the AS subscale was acceptable ($\alpha=0.71$).

Patient health questionnaire anxiety and depression scale

The Patient Health Questionnaire Anxiety and Depression Scale (PHQ-ADS; Kroenke et al., 2016) is the combination of the seven items from the Generalized Anxiety Scale-7 (GAD-7; Spitzer et al., 2006) assessing generalized anxiety symptoms and the nine items from the Patient Health Questionnaire (PHQ-9; Kroenke et al., 2001) assessing depression symptoms. The PHQ-ADS was used as a continuous measure of general emotional psychopathology and served as the first of two sequential intermediate variables in the present model. A sample item from the GAD-7 reads "In the past month (30 days), how often have you been bothered by feeling nervous, anxious, or on edge?" (Spitzer et al., 2006); a sample item from the PHQ-9 reads "In the past month (30 days) how often have you been bothered by little interest or pleasure in doing things?" (Kroenke et al., 2001). Participants could respond with 0 = *Not at all*, 1 = *Several days*, 2 = *More than half the days*, 3 = *Nearly every day*, or *I prefer not to say* (treated as missing) for total scores that range from 0 to 48, where higher scores are indicative of greater emotional distress (Kroenke et al., 2016). Prior work supports the strong psychometric properties of the PHQ-ADS (Kroenke et al., 2016). The Cronbach's alpha reliability estimate for the PHQ-ADS in the present study was excellent ($\alpha = 0.93$).

Brief cannabis motives measure

The Brief Cannabis Motives Measure (BCAMM; Bartel et al., 2023) consists of six items measuring different motives for cannabis use over the past 30 days, including coping-with-anxiety, coping-with-depression, conformity, enhancement, social, and expansion motives. Students were invited to complete the BCAMM only if they had indicated cannabis use within the past month. A sample item (conformity) reads, "In the past 30 days, I've used cannabis because I didn't want to feel left out (e.g., to be liked or to fit in with a group I like)". Participants could respond to each item using a visual analog scale ranging from 0 = *Never* to 100 = *Always*, where higher scores reflect greater endorsement of the related cannabis use motive. Given that high correlation between coping-with-anxiety and coping-with-depression motives was both expected (Glodosky & Cutler, 2020) and observed ($r=0.721$) in the present study, and given the prevalence of general coping in the extant literature (e.g., Johnson et al., 2010), we opted to combine these items into one general coping motive variable to use as the second of two chained intermediate variables alongside the correlated variables of conformity, enhancement, social, and expansion cannabis use motives. The BCAMM has good convergent validity with the 25-item Marijuana Motives Measure (Simons et al., 1998), test-retest reliability, and predictive validity (Bartel et al., 2023). Save for the two-item coping motives scale, BCAMM motives were tapped using a single item each;

therefore, Cronbach's alpha reliability estimates are not provided.

Brief marijuana consequences questionnaire

Participants who reported past-month cannabis use were invited to respond to the 21-item Brief Marijuana Consequences Questionnaire (BMACQ; Simons et al., 2012). The BMACQ measured the number of cannabis-related problems (e.g., impaired control, diminished self-care, academic/occupational consequences) that the participants experienced over the past month; it served as one of two correlated dependent variables in the present study. A sample item is, "I have been less physically active because of my marijuana use", to which participants could respond 0=No, 1=Yes, or *I prefer not to say* (treated as missing). Endorsed items were tallied; possible total scores ranged from 0 to 21 with higher scores indicative of greater past-month cannabis-related problems. An internal consistency analysis for the total BMACQ scores revealed a good Cronbach's alpha of 0.88, comparable with previous work ($\alpha=0.95$; Simons et al., 2012).

Cannabis use frequency

Participants were asked "In the past 30 days, how often did you use cannabis?" to assess their past-month cannabis use frequency. Response options included 1=Not in the past 30 days, 2=1 day in the past 30 days, 3=2–3 days in the past 30 days, 4=1–2 days per week, 5=3–4 days per week, 6=5–6 days per week, 7=Daily, 99=Do not know/not sure, or *I prefer not to say* (treated as missing). This measure of cannabis use frequency served as the second of two correlated outcome variables in the present study.

Data analytic strategy

Our analyses were conducted using SPSS Statistics version 28 (IBM Corp, 2021) and Mplus version 8.11 (Muthén & Muthén, 1998–2017). Descriptive statistics were obtained for all variables of interest and the bivariate correlation coefficients between all variables were calculated using listwise deletion ($n=442$). Hypotheses were tested using path analysis with full information maximum likelihood ($n=444$): a single chained indirect effects model was run with AS specified as the independent variable, leading to emotional psychopathology and cannabis use motives as sequential intermediate variables; the dependent variables included cannabis use frequency and cannabis-related problems. Bootstrapping techniques with 5,000 replications were used to test indirect effects using 95% confidence intervals [CI], allowing for the evaluation of the links between AS and cannabis-related problems and cannabis use frequency through emotional psychopathology and coping, conformity, enhancement, social, and/or expansion motives for cannabis use. The model included biological sex as a covariate. All indirect effects were considered to be supported if the corresponding bootstrapped 95% CIs did not cross zero (Hayes, 2022).

Results

Descriptive statistics

Sample descriptives are provided in Table 1. While 1,318 participants completed the UniVenture screening survey, 481 participants (36.5%) used cannabis in the past month. This is high relative to the 26.1% of participants who reported past-month cannabis use in another Canadian undergraduate sample (Bradley et al., 2024). Furthermore, past-month cannabis use frequency in our sample was high relative to national averages. For instance, 50.1% of our sample used cannabis 1–3 days in the past month compared to 14% found in a sample of over 40,000 post-secondary students aged 17–25 years from across Canada (Health Canada, 2024).

Table 1. Sample descriptives.

	N	%
Gender		
Woman	364	75.7%
Man	107	22.2%
Non-binary	7	1.5%
Transgender	1	0.2%
Genderfluid	1	0.2%
Missing	1	0.2%
Biological sex		
Female	372	77.3%
Male	108	22.5%
Missing	1	0.2%
Year of study		
First	234	48.6%
Second	247	51.4%
Age		
18 years	149	31.0%
19 years	199	41.4%
20 years	86	17.9%
21 years	20	4.2%
22 years	10	2.1%
23 years	8	1.7%
24 years	7	1.5%
25 years	2	0.4%
Ethnicity		
White	394	81.9%
Indigenous/First Nations/ Metis/Inuit	20	4.2%
South Asian	18	3.7%
Arab/West Indian	17	3.5%
Black	14	2.9%
Latin American	11	2.3%
Chinese	10	2.1%
Filipino	6	1.2%
South East Asian	5	1.0%
Korean	4	0.8%
Japanese	1	0.2%
Other	16	3.3%
Employment status		
Unemployed	254	52.8%
Part-time	208	43.2%
Full-time	13	2.7%
I prefer not to say	6	1.2%
Past-month cannabis use		
1 day in the past 30 days	98	20.4%
2 or 3 days in the past 30 days	143	29.7%
1 or 2 day(s) per week	70	14.6%
3 or 4 days per week	50	10.4%
5 or 6 days per week	32	6.7%
Daily	88	18.3%

Note. $N=481$. Participants were allowed to endorse more than one ethnicity to recognize multiethnic identities. The mean [$\pm$ SD] age of the sample was 19.17 [1.24] years. In the past month, participants used cannabis 1 or 2 day(s) per week on average.

Table 2. Descriptive statistics and bivariate correlations for the predictor, outcome, and intermediate variables.

Variable	<i>M</i>	<i>SD</i>	1.	2.	3.	4.	5.	6.	7.	8.	9.
1. Anxiety Sensitivity	13.19	2.75	–								
2. Emotional Psychopathology	21.67	11.23	.356**	–							
			[.272, .435]								
3. Coping Motive	44.14	33.81	.158**	.337**	–						
			[.066, .247]	[.252, .417]							
4. Conformity Motive	23.07	29.22	.104*	.093	.062	–					
			[.011, .196]	[.000, .185]	[–0.031, .155]						
5. Enhancement Motive	69.61	29.96	–0.069	.005	.449**	–0.033	–				
			[–0.161, .025]	[–0.088, .098]	[.371, .520]	[–0.126, .060]					
6. Social Motive	45.43	33.59	–0.016	–0.011	.171**	.323**	.331**	–			
			[–0.109, .078]	[–0.105, .082]	[.079, .260]	[.237, .404]	[.244, .411]				
7. Expansion Motive	37.29	34.73	.016	.003	.386**	.086	.398**	.211**	–		
			[–0.077, .109]	[–0.090, .096]	[.304, .463]	[–0.008, .177]	[.316, .473]	[.120, .298]			
8. Cannabis-related problems	2.82	3.74	.105*	.210**	.477**	.113*	.278**	.150**	.240**	–	
			[.012, .196]	[.119, .297]	[.401, .546]	[.020, .204]	[.190, .362]	[.058, .240]	[.149, .325]		
9. Cannabis use frequency	4.03	1.76	.003	.094*	.522**	–0.055	.423**	.172**	.328**	.626**	–
			[–0.090, .097]	[.000, .185]	[.450, .586]	[–0.148, .038]	[.342, .496]	[.079, .261]	[.242, .408]	[.565, .679]	

Note. *M* = Mean. *SD* = Standard Deviation. Anxiety Sensitivity was measured using the Substance Use Risk Profile Scale (SURPS; Woicik et al., 2009); Emotional Psychopathology was measured using the Patient Health Questionnaire Anxiety and Depression Scale (Kroenke et al., 2016); Coping, Conformity, Enhancement, Social, and Expansion Motives were measured using the Brief Cannabis Motives Measure (BCAMM; Bartel et al., 2023); Past month cannabis-related problems was measured using the Brief Marijuana Consequences Questionnaire (BMACQ; Simons et al., 2012); Past month cannabis use frequency was measured using a single author-composed item. ** Correlation significant at the 0.01 level (2-tailed). * Correlation significant at the 0.05 level (2-tailed). Listwise deletion: *N* = 442.

Additionally, 24.9% of our sample reported daily or almost daily cannabis use (i.e., 5+ days per week) in the past month compared to 8% found in the national sample (Health Canada, 2024).

Means, standard deviations, and bivariate correlations between the independent variable, two correlated dependent variables, and the sequential intermediate variables are provided in Table 2. Participants in the current study reported an average of 2.82 (*SD* = 3.74) cannabis-related problems on the BMACQ. This finding is comparable to other Canadian samples. For instance, Doggett et al. (2023) reported a mean of 2.53 (*SD* = 3.91) prior to legalization and a mean of 1.45 (approximated from their Figure 2b) at the most recent post-legalization time point from October 1, 2019, to February 16, 2020. While there are no formal clinical cutoffs for the BMACQ, these comparisons suggest that cannabis-related problems in our sample are within the expected range for Canadian emerging adults.

Chained indirect effects model

We tested a chained indirect effects model examining the indirect effects of AS on the correlated outcomes of cannabis use frequency and cannabis-related problems *via* emotional psychopathology and, in turn, five correlated cannabis use motives (coping, conformity, enhancement, social, and expansion). All variables were included in a single path model, where estimates and indirect effects were tested using bootstrapped 95% CIs.

We tested the fit of our model using traditional fit indices: chi-square (χ^2), the comparative fit index (CFI), the root mean square error of approximation (RMSEA), and the standardized root mean square residual (SRMR). Currently accepted rules of thumb for evaluating model fit include lower χ^2 values, suggesting better model fit; $p > 0.05$ is ideal

as it reflects no significant difference between the observed data and the model (Kline, 2016). The χ^2 test is sensitive to large samples, however, so it is the least reliable metric under evaluation and less sensitive fit indices should be used in larger samples (Fan et al., 1999). CFI measures fit improvement by comparing the indices of a specified model to the indices of a null model. Values can range from 0.0–1.0. 1.0 is a perfect fit and values above 0.95 are considered excellent fit (Bentler, 1990; Hu & Bentler, 1999; Kline, 2016). RMSEA assesses the difference between the observed and model-implied covariance matrices while considering model complexity; values of 0 indicate perfect model fit, values ≤ 0.06 are acceptable (Browne & Cudeck, 1992; Hu & Bentler, 1999; Kline, 2016; Steiger & Lind, 1980). SRMR is the standardized difference between observed and predicted correlations; values of 0 indicate perfect model fit, but values < 0.08 are acceptable (Diamantopoulos & Siguaw, 2000; Hu & Bentler, 1999). Our model fit the data very well: $\chi^2 (9) = 23.216$, $p = 0.006$, CFI = 0.982, RMSEA = 0.060, 90% CI [0.030, 0.090], SRMR = 0.021.

Full standardized (β) results of the chained indirect effects model are presented in Figure 1. Results are presented as both unstandardized *b* (*SE*) and standardized β [95% CI] to aid interpretation. The model included biological sex as a covariate. AS was positively associated with emotional psychopathology ($b = 1.403$ (0.221); $\beta = 0.403$, 95% bootstrap CI [0.284, 0.517]). In turn, emotional psychopathology was significantly positively associated with coping motives ($b = 0.820$ (0.129); $\beta = 0.310$, 95% bootstrap CI [0.217, 0.402]) and conformity motives ($b = 0.241$ (0.116); $\beta = 0.105$, 95% bootstrap CI [0.012, 0.201]), but not with social, enhancement, or expansion motives. Among the cannabis use motives, as hypothesized, coping motives were significantly positively associated with both past month cannabis use frequency ($b = 0.019$ (0.002); $\beta = 0.351$, 95% bootstrap CI [0.267,

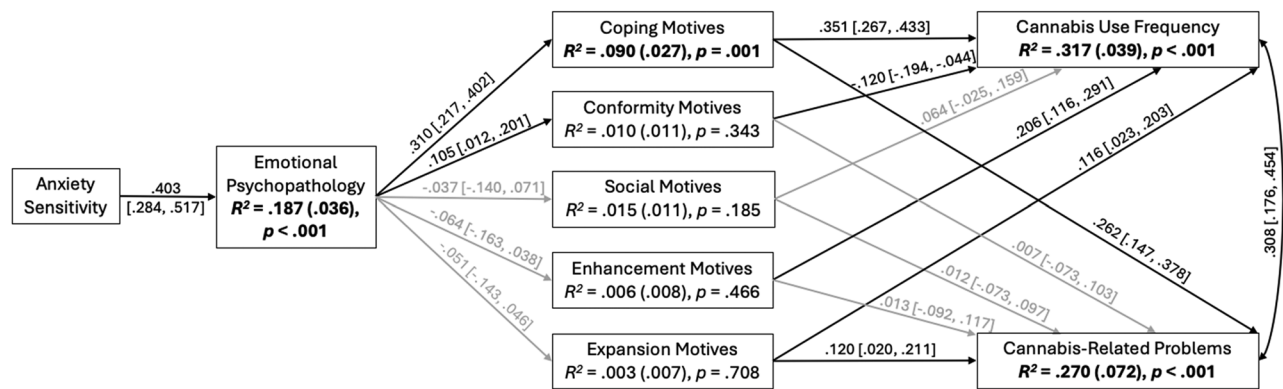


Figure 1. Path estimates testing chained indirect effects of the link between anxiety sensitivity and cannabis-related problems and past-month cannabis use frequency.

Note. All path estimates presented as standardized coefficient [95% bootstrap confidence interval]. All paths were considered to be supported if the associated 95% CI did not include zero. R^2 values represent the proportion of variance in the dependent variable that can be explained by the independent and chained intermediate variables.

0.433]) and cannabis-related problems ($b=0.050$ (0.013); $\beta = 0.262$, 95% bootstrap CI [0.147, 0.378]). Contrary to hypotheses, conformity motives were significantly negatively associated with cannabis use frequency ($b=-0.007$ (0.002); $\beta = -0.120$, 95% bootstrap CI [-0.194, -0.044]) and were not significantly associated with cannabis-related problems. Enhancement motives were significantly positively associated with cannabis use frequency ($b=0.012$ (0.003); $\beta = 0.206$, 95% bootstrap CI [0.116, 0.291]), but not cannabis-related problems, and expansion motives were significantly positively associated with both cannabis use frequency ($b=0.006$ (0.002); $\beta = 0.116$, 95% bootstrap CI [0.023, 0.203]) and cannabis-related problems ($b=0.022$ (0.009); $\beta = 0.120$, 95% bootstrap CI [0.020, 0.211]). Social motives were not significantly associated with either cannabis use frequency or cannabis-related problems.

Importantly, analyses of the specific indirect effects partially supported hypotheses by revealing that AS had significant positive indirect effects on both cannabis use frequency ($b=0.021$ (0.005); $\beta = 0.044$ (0.011), 95% CI [0.024, 0.068]) and cannabis-related problems ($b=0.058$ (0.019); $\beta = 0.033$ (0.011), 95% CI [0.015, 0.056]) through emotional psychopathology and, in turn, coping motives. No other indirect pathways reached significance, positively or negatively including the additional hypothesized indirect effect through emotional psychopathology and, in turn, conformity motives. Table 3 presents all the standardized results from the specific indirect effects analysis.

Notably, the overall model accounted for 31.7% of the variance in the cannabis use frequency variable ($R^2 = 0.317$, $SE = 0.039$, $p < 0.001$) and 27.0% of the variance in the cannabis-related problems variable ($R^2 = 0.270$, $SE = 0.072$, $p < 0.001$). We found no support for direct effects, suggesting that emotional psychopathology and, in turn, coping cannabis use motives fully account for the links between AS and cannabis use frequency and related problems.

Discussion

This study examined if emotional psychopathology and, in turn, negative reinforcement motives for cannabis use,

Table 3. Specific indirect effects of anxiety sensitivity and emotional psychopathology on past 30-day cannabis use frequency and cannabis-related problems through cannabis use motives

Effects	β	SE	95% bootstrapped CI
AS → Emotional Psychopathology → Coping Motives → Cannabis Use Frequency	.044	.011	.024, .068
AS → Emotional Psychopathology → Conformity Motives → Cannabis Use Frequency	-0.005	.003	-0.012, .000
AS → Emotional Psychopathology → Enhancement Motives → Cannabis Use Frequency	-0.005	.005	-0.017, .003
AS → Emotional Psychopathology → Social Motives → Cannabis Use Frequency	-0.001	.002	-0.006, .002
AS → Emotional Psychopathology → Expansion Motives → Cannabis Use Frequency	-0.002	.003	-0.009, .002
AS → Emotional Psychopathology → Coping Motives → Cannabis-Related Problems	.033	.011	.015, .056
AS → Emotional Psychopathology → Conformity Motives → Cannabis-Related Problems	.000	.002	-0.004, .005
AS → Emotional Psychopathology → Enhancement Motives → Cannabis-Related Problems	.000	.002	-0.005, .003
AS → Emotional Psychopathology → Social Motives → Cannabis-Related Problems	.000	.001	-0.003, .002
AS → Emotional Psychopathology → Expansion Motives → Cannabis-Related Problems	-0.002	.003	-0.009, .002

Note. AS = Anxiety Sensitivity measured using Substance Use Risk Profile Scale (Woicik et al., 2009); Emotional Psychopathology measured using Patient Health Questionnaire Anxiety and Depression Scale (Kroenke et al., 2016); Coping, Conformity, Enhancement, Social, and Expansion Motives measured using Brief Cannabis Motives Measure (Bartel et al., 2023); Past month cannabis-related problems measured using the Brief Marijuana Consequences Questionnaire (BMACQ; Simons et al., 2012); Past month cannabis use frequency measured using a single author-composed item. Bolding denotes statistical significance.

specifically coping and conformity motives, served as significant intermediary variables in the hypothesized indirect association between AS and both cannabis use frequency and cannabis-related problems. Our findings partially supported our hypotheses: coping was important as a second intermediary variable (following emotional psychopathology) in both the AS-cannabis use frequency link as well as the AS-cannabis-related problems link, producing significant positive indirect effects of small magnitude. However, contrary to hypothesis, conformity was not significantly implicated as a second intermediary variable in either the AS-cannabis use frequency link or the AS-cannabis-related problems link. Enhancement, social, and expansion motives were also not significant intermediate variables in these AS-cannabis-related outcome links, demonstrating specificity of the findings to the intermediary role of coping motives. There was no evidence of a remaining direct effects in the model from AS to either cannabis-related problems or cannabis use frequency, suggesting that emotional psychopathology and, in turn, coping motives fully explain both AS-cannabis outcome associations. Notably, the full model explained 31.7% of the variance in cannabis use frequency and 27.0% of the variance in cannabis-related problems, leaving 68.3% and 73.0% of the variance unaccounted for. Non-coping cannabis use motives were non-significant contributors to these links and were found to explain very little of the variance in the outcomes. Other personality factors like impulsivity or sensation seeking may add to the percent of variance explained by our model, as might other theoretically relevant personality factors like high neuroticism or low conscientiousness. These results suggest that for those emerging adult undergraduates in Canada who are higher in AS, targeting emotional symptoms and coping motives for cannabis use could help with mitigating more frequent and problematic cannabis use. Future research should determine the specificity of this model to AS by controlling for trait anxiety with a measure like the State-Trait Anxiety Inventory—Trait version (STAI-T; Spielberger, 1983) and/or negative affectivity with a validated measure like the Revised NEO Personality Inventory (NEO-PI-R; Costa & McCrae, 2008) Neuroticism subscale.

Past work by Johnson et al. (2010) showed that cannabis coping motives mediated the positive link between AS and cannabis dependence levels (i.e., a specific and severe form of cannabis-related problem) among emerging adults in a US sample. The present study replicated and extended this work to include cannabis use frequency and a range of more general cannabis-related problems, finding support for both emotional psychopathology and, in turn, coping motives as intermediate variables in the links between AS and both past-month cannabis-related problems and past-month cannabis use frequency in a relatively large sample of Canadian emerging adult undergraduates who recently used cannabis (i.e., within the past month).

The present study was the first to evaluate conformity motives for cannabis use as a potential chained second intermediary variable (after emotional symptoms) in the links between AS and cannabis use frequency and cannabis-

related problems. Past work has found that those with higher AS tend to use cannabis to conform to social pressures (Comeau et al., 2001) and to reduce anxiety felt in social situations (Hecimovic et al., 2014). This could potentially increase young people who have elevated AS's risk for increased cannabis use and cannabis-related problems, given the established links of conformity motives with cannabis use and related problems (Simons et al., 1998). The results of our path analysis suggest that, contrary to hypotheses, conformity motives for cannabis use played a non-significant role in explaining the associations between AS and cannabis use and AS and cannabis-related problems. It is possible that this null finding could be due to our use of the SURPS for measuring AS: the SURPS AS subscale does not include any items assessing the social concerns facet of AS, which may be most relevant for conformity motives; future research should make use of multi-dimensional AS tools like the Anxiety Sensitivity Index-3 (ASI-3; Taylor et al., 2007) which captures AS-related concerns in social as well as cognitive and physical concern domains. Furthermore, the motivational model of substance use (Cooper et al., 2016) posits that substance use behaviors are positively or negatively valenced (i.e., approach or avoid) and internally or externally focused (i.e., directed to oneself or others). For example, coping is considered self-focused avoidance whereas conformity is other-focused avoidance. Given that AS is an internal experience, it is possible that our null conformity findings could be attributed to conformity motives' external focus. Thus, while students with elevated AS may be at increased risk of using cannabis to conform with social pressures (given the significant a-path in the model), this appears to be a much weaker mechanism for their risk of more frequent and problematic cannabis use compared to their cannabis use to cope with emotional distress (i.e., anxiety and depression) given the indirect effects findings.

It is also important to consider the context in which our data were collected. Specifically, data collection occurred in spring 2021, during the second wave of the COVID-19 pandemic. At this time, the number of confirmed cases in Canada surpassed one million (Government of Canada, 2023) and varying degrees of social distancing restrictions and stay-at-home orders were in place across the country, including universities largely continuing to rely on remote learning models (Lorenzo et al., 2023; Plett et al., 2022; Public Health Agency of Canada, 2021; Zhai & Du, 2020). These restrictions likely reduced opportunities for in-person peer interaction, so it could be argued that the perceived need to conform to peer behavior may have been less salient during these periods. It is possible that conformity motives may be a significant intermediate variable in the AS-cannabis outcomes link during times where students are engaging in more in-person social interactions.

Conversely, the prolonged stress, uncertainty, isolation, and loneliness of the pandemic likely amplified coping-related cannabis use motives (Statistics Canada, 2021). During the COVID-19 pandemic, 20% and 10% of respondents in a nationally representative sample reported high-to-extremely-high levels of anxiety and depression, respectively, and as a result, 29% of the sample reported increasing their cannabis

use (Dozois & Mental Health Research Canada, 2021). Individuals previously diagnosed with an anxiety disorder or depression were found to increase their cannabis use during the pandemic by 47% and 41%, respectively (Dozois & Mental Health Research Canada, 2021). Furthermore, Statistics Canada (2021) found that in January 2021, 16% of Canadians reported past-month cannabis use. Among those who used cannabis, 34% endorsed increasing their consumption compared to pre-pandemic times, and 12% of reported decreasing their cannabis use during the pandemic (Statistics Canada, 2021). Of those who increased their use, reasons included stress, boredom, and loneliness; of those who decreased their use, reasons included disliking the effects of cannabis and decreased opportunities for socializing (Statistics Canada, 2021).

Since AS is a risk factor for both anxiety and depression and given the context of the pandemic being associated with increases in anxiety, depression and, for some, cannabis use, the pandemic context may have impacted our results by exacerbating the link of AS to adverse cannabis outcomes through emotional symptoms and, in turn, coping motives. As such, caution should be exercised in generalizing these findings to post-pandemic contexts wherein pandemic uncertainties have dissipated and peer contact and social pressures have resumed. Future work would benefit from replication with post-pandemic data to determine if conformity motives play a stronger role in the link between AS and cannabis use frequency and cannabis-related problems outside of the pandemic context and whether our findings for emotional symptoms and coping motives persist. If replicated, these results could offer a more nuanced understanding of why emerging adults with AS use cannabis, which in turn may inform targets for interventions designed to mitigate their risk for cannabis use and related problems.

Limitations

Cross-sectional research provides data captured at a single point in time, which limits causal inference (Chilcoat & Breslau, 1998). Ideally, as causal associations are processes that inherently unfold over time, they are best tested with longitudinal or experimental research designs (i.e., daily diary, ecological momentary assessment, or prospective cohort studies) to capture real-time motives and affect and infer temporality and causality more confidently (Maxwell et al., 2011). It is also possible that reverse pathways may exist within the overall model: for instance, while AS may lead to increases in emotional distress, emotional distress may also lead to increases in AS over time (McLaughlin & Hatzenbuehler, 2009). Another example is that while emotional distress might lead to coping motives, coping motives (as an avoidance strategy) might lead to increases in emotional distress over time (Buckner et al., 2007). Some argue that cross-sectional research may be used as an initial step toward understanding the mechanisms that may underlie an association of interest with the caveat that temporal precedence cannot be ascertained (Hayes, 2022). Our examination of emotional psychopathology and various negative and

positive reinforcement cannabis use motives as intermediate variables in the indirect links between AS and cannabis use frequency and cannabis-related problems was novel. We were the first to examine cannabis use frequency and cannabis-related problems broadly as correlated outcomes and the first to examine this model in a sample of Canadian emerging adults who had recently used cannabis (i.e., within the past month). We were also the first to examine a chained indirect effects model with intermediary variables of emotional symptoms and, in turn, specific cannabis use motives. Thus, our cross-sectional study represents a beneficial first step in understanding the mechanisms that may be involved in explaining the elevated risk for more frequent and problematic cannabis use among emerging adults with higher AS. Future research should consider going beyond preliminary cross-sectional designs and test these proposed pathways (along with reverse or reciprocal pathways) using longitudinal and/or experimental designs.

Another limitation is the use of single-item measures to assess cannabis use motives. While single-item measures may be more susceptible to measurement error inflation and attenuating associations than longer-form scales, and while single items preclude reliability estimation, the items used in this study have been validated by Bartel et al. (2023) and provide a practical advantage in large-scale surveys like the UniVenture screening where participant burden was a concern. Future research should consider using full length validated multi-item motives scale (e.g., Marijuana Motives Measure; Simons et al., 1998) to mitigate the above-noted issues.

This study is also limited by fact that AS was measured with the SURPS (Woicik et al., 2009), which assesses AS broadly using five items. The alpha for the SURPS AS subscale, while acceptable, was lower than for other longer and more well-established measures of AS, such as the ASI-3 (Taylor et al., 2007), thus introducing extra measurement error. Measures like the ASI-3 may provide a more detailed and multi-dimensional perspective on AS that captures concerns in the physical, cognitive, and social domains of AS and should be considered for use in future research.

Regarding generalizability, our model was derived from models used in the alcohol field (Cooper et al. 2016) and our findings extend these models to cannabis use. Future studies should test potential extensions to other substances such as tobacco and opioids. Our sample was also predominantly female (77.3%) and White (81.9%) first- and second-year undergraduate students; thus, the generalizability of our results to males, ethnically diverse groups, older emerging adults, non-students, and those who use cannabis infrequently (i.e., less frequently than once a month) may be limited. Future research should consider more targeted recruitment efforts to mitigate these issues. Finally, as noted earlier, our data were collected during the COVID-19 pandemic, and therefore, our results may have limited generalizability beyond this unique time.

Conclusions

The findings from this study provide support for the use of personality-targeted interventions to reduce the risk of problematic cannabis use among emerging adult undergraduates. Specifically, our results suggest that emotional psychopathology and coping motives for cannabis use are significantly implicated in the increased risk for more frequent and problematic cannabis use among undergraduates with higher AS, highlighting key targets for intervention. Specifically, interventions may want to focus on teaching higher AS students to both manage their distress (i.e., anxiety and/or depression) and help them to develop less risky strategies for coping that do not involve cannabis use. This aligns with the goals of the UniVenture risky substance use prevention project, which aims to equip students with more positive coping strategies and skills targeted toward their particular personality vulnerabilities (see Lambe et al., 2023; Yunus et al., 2022). The present study provides valuable insights that may be used to inform future iterations of the UniVenture intervention, particularly for higher AS emerging adult undergraduates, to reduce their risk of experiencing adverse outcomes from cannabis use.

Acknowledgements

Authors extend their sincere thanks to the UniVenture Consortium which includes researchers and project staff from the five Canadian university data collection sites. We would specifically like to thank Laura Lambe, Stephanie Cooper, Audrey Livet, Marion Audet, Nora Frapp, Naama Kronstein, Vanessa Morris, Raquel Nogueira-Arjona, Phillippe Pétrin-Pomerleau, Cassidy Wallis, Katherine Rose, Ramin Rostampour, Annie Wu, and Violet Cieslik for their research assistance.

Declaration of interest

The authors report no conflicts of interest.

Funding

This study was funded through a Social Sciences and Humanities Research Council (SSHRC) Partnership Grant [Grant#: 895-2019-1021; PI SHS]. HCRB's work on the project was supported by the Nova Scotia Research and Innovation Graduate Scholarship, a Maritime SPOR SUPPORT Unit Trainee Support Award, a Scotia Scholar's Masters Award from Research Nova Scotia, a Canada-Graduate Scholarship-Master's award, and an Ontario Graduate Scholarship. PGT is funded through the Dr. Paul Janssen Chair in Psychotic Disorders (Dalhousie). PJC is funded through a CIHR Tier 1 Canada Research Chair in Preventative Mental Health and Addiction. FMY was funded through a Mitacs Accelerate Post-Doctoral Fellowship program in collaboration with Injury Free Nova Scotia. SHS is funded through a CIHR Tier 1 Canada Research Chair in Addiction and Mental Health.

ORCID

Haley C.R. Bernusky  <http://orcid.org/0000-0001-8996-0523>

Data availability statement

Interested researchers may request access to the deidentified data by contacting the corresponding author (sstewart@dal.ca). Data may be shared with qualified researchers upon reasonable request and pending appropriate ethical approvals.

References

- Arnett, J. J., Žukauskienė, R., & Sugimura, K. (2014). The new life stage of emerging adulthood at ages 18–29 years: Implications for mental health. *The Lancet. Psychiatry*, 1(7), 569–576. [https://doi.org/10.1016/S2215-0366\(14\)00080-7](https://doi.org/10.1016/S2215-0366(14)00080-7)
- Bartel, S. J., Sherry, S. B., Mahu, I. T., & Stewart, S. H. (2023). Development of brief alcohol and cannabis motives measures: Psychometric evaluation using expert feedback and longitudinal methods. *Cannabis (Albuquerque, N.M.)*, 6(1), 34–49. <https://doi.org/10.26828/cannabis/2023.01.004>
- Bentler, P. M. (1990). Comparative fit indexes in structural models. *Psychological Bulletin*, 107(2), 238–246. <https://doi.org/10.1037/0033-2909.107.2.238>
- Black, N., Stockings, E., Campbell, G., Tran, L. T., Zagic, D., Hall, W. D., Farrell, M., & Degenhardt, L. (2019). Cannabinoids for the treatment of mental disorders and symptoms of mental disorders: A systematic review and meta-analysis. *The Lancet Psychiatry*, 6(12), 995–1010. [https://doi.org/10.1016/S2215-0366\(19\)30401-8](https://doi.org/10.1016/S2215-0366(19)30401-8)
- Bonn-Miller, M. O., Zvolensky, M. J., & Bernstein, A. (2007). Marijuana use motives: Concurrent relations to frequency of past 30-day use and anxiety sensitivity among young adult marijuana smokers. *Addictive Behaviors*, 32(1), 49–62. <https://doi.org/10.1016/j.addbeh.2006.03.018>
- Bradley, A. H. M., Salmon, M., Wohl, M. J. A., & Howard, A. L. (2024). Impact of legalization on cannabis use, attitudes, and purchasing preferences: A repeated cross-sectional survey of Canadian young adults. *Cannabis (Albuquerque, N.M.)*, 7(2), 65–76. <https://doi.org/10.26828/cannabis/2024/000203>
- 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>
- Browne, M. W., & Cudeck, R. (1992). Alternative ways of assessing model fit. *Sociological Methods & Research*, 21(2), 230–258. <https://doi.org/10.1177/0049124192021002005>
- Buckner, J. D., Bonn-Miller, M. O., Zvolensky, M. J., & Schmidt, N. B. (2007). Marijuana use motives and social anxiety among marijuana using young adults. *Addictive Behaviors*, 32(10), 2238–2252. <https://doi.org/10.1016/j.addbeh.2007.04.004>
- Castellanos-Ryan, N., & Conrod, P. J. (2012). Personality and substance misuse: Evidence for a four-factor model of vulnerability. In J. C. Verster, K. Brady, M. Galanter, & P. J. Conrod (Eds.), *Drug abuse and addiction in medical illness* (pp. 47–62). Springer. https://doi.org/10.1007/978-1-4614-3375-0_4
- Chilcoat, H. D., & Breslau, N. (1998). Investigations of causal pathways between PTSD and drug use disorders. *Addictive Behaviors*, 23(6), 827–840. [https://doi.org/10.1016/S0306-4603\(98\)00069-0](https://doi.org/10.1016/S0306-4603(98)00069-0)
- Comeau, M. 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/10.1016/S0306-4603\(01\)00238-6](https://doi.org/10.1016/S0306-4603(01)00238-6)
- 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: Journal of the Society of Psychologists in Addictive Behaviors*, 14(3), 243–256. <https://doi.org/10.1037/0893-164X.14.3.243>
- 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: Volume 1* (pp. 375–421). Oxford University Press. <https://doi.org/10.1093/oxfordhb/9780199381678.013.017>
- Costa, P. T., & McCrae, R. R. (2008). The Revised NEO Personality Inventory (NEO-PI-R). In G. J. Boyle, G. Matthews, & D. H. Saklofske (Eds.), *The SAGE handbook of personality theory and assessment, Personality measurement and testing* (Vol. 2, pp. 179–198). Sage Publications. <https://doi.org/10.4135/9781849200479.n9>
- Diamantopoulos, A., & Siguaw, J. A. (2000). *Introducing LISREL*. SAGE Publications. <https://doi.org/10.4135/9781849209359>
- Doggett, A., Belisario, K., McDonald, A. J., Ferro, M. A., Murphy, J. G., & MacKillop, J. (2023). Cannabis use frequency and cannabis-related consequences in high-risk young adults across cannabis legalization. *JAMA Network Open*, 6(9), e2336035. <https://doi.org/10.1001/jama-networkopen.2023.36035>
- Dozois, D. J. A., Mental Health Research Canada. (2021). Anxiety and depression in Canada during the COVID-19 pandemic: A national survey. *Canadian Psychology/Psychologie Canadienne*, 62(1), 136–142. <https://doi.org/10.1037/cap0000251>
- Elsaid, S., Wang, R., Kloiber, S., Haines-Saah, R., Hassan, A. N., & Le Foll, B. (2024). Expectancies of the effects of cannabis use in individuals with social anxiety disorder (SAD). *Brain Sciences*, 14(3), 246. <https://doi.org/10.3390/brainsci14030246>
- Fan, X., Thompson, B., & Wang, L. (1999). Effects of sample size, estimation methods, and model specification on structural equation modeling fit indexes. *Structural Equation Modeling: A Multidisciplinary Journal*, 6(1), 56–83. <https://doi.org/10.1080/10705519909540119>
- Fox, C. L., Towe, S. L., Stephens, R. S., Walker, D. D., & Roffman, R. A. (2011). Motives for cannabis use in high-risk adolescent users. *Psychology of Addictive Behaviors: Journal of the Society of Psychologists in Addictive Behaviors*, 25(3), 492–500. <https://doi.org/10.1037/a0024331>
- Glodosky, N. C., & Cuttler, C. (2020). Motives Matter: Cannabis use motives moderate the associations between stress and negative affect. *Addictive Behaviors*, 102, 106188. <https://doi.org/10.1016/j.addbeh.2019.106188>
- Government of Canada. (2023). *Interactive data visualizations of COVID-19*. <https://health-infobase.canada.ca/covid-19/international/>
- Hasin, D. S., Shmulewitz, D., & Sarvet, A. L. (2019). Time trends in US cannabis use and cannabis use disorders overall and by socio-demographic subgroups: A narrative review and new findings. *The American Journal of Drug and Alcohol Abuse*, 45(6), 623–643. <https://doi.org/10.1080/00952990.2019.1569668>
- Hayes, A. F. (2022). *Introduction to mediation, moderation, and conditional process analysis: A regression-based approach* (3rd ed.). The Guilford Press.
- Health Canada. (2021). *Canadian postsecondary education alcohol and drug use survey, 2019/2020*. Government of Canada. <https://health-infobase.canada.ca/alcohol/cpads/>
- Health Canada. (2022). *Canadian cannabis survey 2022: Summary*. Government of Canada. <https://www.canada.ca/en/health-canada/services/drugs-medication/cannabis/research-data/canadian-cannabis-survey-2022-summary.html>
- Health Canada. (2024). *Canadian postsecondary education alcohol and drug use survey, 2021–2022: Summary*. Government of Canada. <https://health-infobase.canada.ca/alcohol/cpads/index.html>
- 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>
- Hu, L., & Bentler, P. M. (1999). Cutoff criteria for fit indexes in covariance structure analysis: Conventional criteria versus new alternatives. *Structural Equation Modeling: A Multidisciplinary Journal*, 6(1), 1–55. <https://doi.org/10.1080/10705519909540118>
- IBM Corp. (2021). *IBM SPSS Statistics for Macintosh (Version 28) [software]*.
- Johnson, K., Mullin, J. L., Marshall, E. C., Bonn-Miller, M. O., & Zvolensky, M. (2010). Exploring the mediational role of coping motives for marijuana use in terms of the relation between anxiety sensitivity and marijuana dependence. *The American Journal on Addictions*, 19(3), 277–282. <https://doi.org/10.1111/j.1521-0391.2010.00041.x>
- Khakpoor, S., Saed, O., & Shahsavari, A. (2019). The concept of “anxiety sensitivity” in social anxiety disorder presentations, symptomatology, and treatment: A theoretical perspective. *Cogent Psychology*, 6(1), 1617658. <https://doi.org/10.1080/23311908.2019.1617658>
- Kline, R. B. (2016). *Principles and practice of structural equation modeling* (4th ed.). The Guilford Press.
- Knapp, A. A., Allan, N. P., Cloutier, R., Blumenthal, H., Moradi, S., Budney, A. J., & Lord, S. E. (2021). Effects of anxiety sensitivity on cannabis, alcohol, and nicotine use among adolescents: Evaluating pathways through anxiety, withdrawal symptoms, and coping motives. *Journal of Behavioral Medicine*, 44(2), 187–201. <https://doi.org/10.1007/s10865-020-00182-x>
- Kroenke, K., Spitzer, R. L., & Williams, J. B. W. (2001). The PHQ-9. *Journal of General Internal Medicine*, 16(9), 606–613. <https://doi.org/10.1046/j.1525-1497.2001.016009606.x>
- Kroenke, K., Wu, J., Yu, Z., Bair, M. J., Kean, J., Stump, T., & Monahan, P. O. (2016). The Patient Health Questionnaire Anxiety and Depression Scale (PHQ-ADS): Initial validation in three clinical trials. *Psychosomatic Medicine*, 78(6), 716–727. <https://doi.org/10.1097/PSY.0000000000000322>
- Lambe, L. J., Yunus, F. M., Moore, M., Keough, M. T., Thompson, K., Krank, M., Conrod, P., & Stewart, S. H. (2023). Inhibited personality traits, internalizing symptoms, and drinking to cope during the COVID-19 pandemic among emerging adults. *Cognitive Behaviour Therapy*, 52(3), 198–212. <https://doi.org/10.1080/16506073.2022.2152726>
- Lorenzo, A., Kthupi, A., Liu, W., Hamza, C., Todorova, A. A., Kuburi, S., Ellis, A. K., Keown-Stoneman, C., Fadel, S. A., & Gagnon, F. (2023). The mental health impact of the COVID-19 pandemic on post-secondary students: A longitudinal study. *Psychiatry Research*, 327, 115401. <https://doi.org/10.1016/j.psychres.2023.115401>
- Maxwell, S. E., Cole, D. A., & Mitchell, M. A. (2011). Bias in cross-sectional analyses of longitudinal mediation: Partial and complete mediation under an autoregressive model. *Multivariate Behavioral Research*, 46(5), 816–841. <https://doi.org/10.1080/00273171.2011.606716>
- McGuckin, T., Ferro, M. A., Hammond, D., Stewart, S., Maloney-Hall, B., Madi, N., Porath, A., & Perlman, C. M. (2021). How high? Trends in cannabis use prior to first admission to inpatient psychiatry in Ontario, Canada, between 2007 and 2017. *Canadian Journal of Psychiatry. Revue Canadienne de Psychiatrie*, 66(12), 1059–1068. <https://doi.org/10.1177/0706743720984679>
- McLaughlin, E. N., Stewart, S. H., & Taylor, S. (2007). Childhood anxiety sensitivity index factors predict unique variance in DSM-IV anxiety disorder symptoms. *Cognitive Behaviour Therapy*, 36(4), 210–219. <https://doi.org/10.1080/16506070701499988>
- McLaughlin, K. A., & Hatzenbuehler, M. L. (2009). Stressful life events, anxiety sensitivity, and internalizing symptoms in adolescents. *Journal of Abnormal Psychology*, 118(3), 659–669. <https://doi.org/10.1037/a0016499>
- 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)
- Muthén, L. K., & Muthén, B. O. (1998–2017). *Mplus user's guide (version 8)*. Los Angeles: Muthén & Muthén. https://www.statmodel.com/download/usersguide/MplusUserGuideVer_8.pdf
- Olatunji, B. O., & Wolitzky-Taylor, K. B. (2009). Anxiety sensitivity and the anxiety disorders: A meta-analytic review and synthesis. *Psychological Bulletin*, 135(6), 974–999. <https://doi.org/10.1037/a0017428>
- Plett, D., Pechlivanoglou, P., & Coyte, P. C. (2022). The impact of provincial lockdown policies and COVID-19 case and mortality rates on anxiety in Canada. *Psychiatry and Clinical Neuroscience*, 76(9), 468–474. <https://doi.org/10.1111/pcn.13437>
- Public Health Agency of Canada. (2021). *Statement from the Chief Public Health Officer of Canada on April 1, 2021*. Government of Canada. <https://www.canada.ca/en/public-health/news/2021/04/statement-from-the-chief-public-health-officer-of-canada-on-april-1-2021.html>
- Schafer, J., & Brown, S. A. (1991). Marijuana and cocaine effect expectancies and drug use patterns. *Journal of Consulting and Clinical Psychology*, 59(4), 558–565. <https://doi.org/10.1037/0022-006X.59.4.558>

- Simons, J. S., 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>
- Simons, J. S., Dvorak, R. D., Merrill, J. E., & Read, J. P. (2012). Dimensions and severity of marijuana consequences: Development and validation of the Marijuana Consequences Questionnaire (MACQ). *Addictive Behaviors*, 37(5), 613–621. <https://doi.org/10.1016/j.addbeh.2012.01.008>
- Spielberger, C. D. (1983). *Manual for the State-Trait Anxiety Inventory STAI (Form Y)*. Mind Garden.
- Spinella, T. C., Bartholomeusz, J., Stewart, S. H., & Barrett, S. P. (2023). Perceptions about THC and CBD effects among adults with and without prior cannabis experience. *Addictive Behaviors*, 137, 107508. <https://doi.org/10.1016/j.addbeh.2022.107508>
- Spinella, T. C., Stewart, S. H., Naugler, J., Yakovenko, I., & Barrett, S. P. (2021). Evaluating cannabidiol (CBD) expectancy effects on acute stress and anxiety in healthy adults: A randomized crossover study. *Psychopharmacology*, 238(7), 1965–1977. <https://doi.org/10.1007/s00213-021-05823-w>
- Spitzer, R. L., Kroenke, K., Williams, J. B. W., & Löwe, B. (2006). A brief measure for assessing generalized anxiety disorder: The GAD-7. *Archives of Internal Medicine*, 166(10), 1092–1097. <https://doi.org/10.1001/archinte.166.10.1092>
- Statistics Canada. (2021). *Alcohol and cannabis use during the pandemic: Canadian Perspectives Survey Series 6*. <https://www150.statcan.gc.ca/n1/daily-quotidien/210304/dq210304a-eng.htm>
- Statistics Canada. (2024). Table 37-10-0103-01. Participation rate in education, population aged 18 to 34, by age group and type of institution attended. <https://doi.org/10.25318/3710010301-eng>
- Steiger, J. H., & Lind, J. M. (1980). Statistically based tests for the number of common factors [Paper presentation] June, Iowa City, IA.
- Stewart, S. H. (2024). Anxiety sensitivity as a transdiagnostic factor in emotional disorders, addictive disorders, and their comorbidities: How basic research informs intervention research. *Canadian Psychology / Psychologie Canadienne*, 65(2), 75–92. <https://doi.org/10.1037/cap0000393>
- Taylor, S., Koch, W. J., Woody, S., & McLean, P. (1996). Anxiety sensitivity and depression: How are they related? *Journal of Abnormal Psychology*, 105(3), 474–479. <https://doi.org/10.1037/0021-843X.105.3.474>
- 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>
- Tibbo, P. G., McKee, K. A., Meyer, J. H., Crocker, C. E., Aitchison, K. J., Lam, R. W., & Crockford, D. N. (2021). Are there therapeutic benefits of cannabinoid products in adult mental illness? *Canadian Journal of Psychiatry. Revue Canadienne de Psychiatrie*, 66(2), 185–194. <https://doi.org/10.1177/0706743720945525>
- van der Pol, P., Liebrechts, N., de Graaf, R., Korf, D. J., van den Brink, W., & van Laar, M. (2013). Predicting the transition from frequent cannabis use to cannabis dependence: A three-year prospective study. *Drug and Alcohol Dependence*, 133(2), 352–359. <https://doi.org/10.1016/j.drugalcdep.2013.06.009>
- 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/10.1016/j.addbeh.2009.07.001>
- Yunus, F. M., Livet, A., Mahmoud, A., Moore, M., Murphy, C. B., Nogueira-Arjona, R., Thompson, K., Keough, M. T., Krank, M. D., Conrod, P. J., & Stewart, S. H. (2022). Is anxiety sensitivity associated with COVID-19 related distress and adherence among emerging adults? *Psych*, 4(4), 934–951. <https://doi.org/10.3390/psych4040069>
- Zhai, Y., & Du, X. (2020). Addressing collegiate mental health amid COVID-19 pandemic. *Psychiatry Research*, 288, 113003. <https://doi.org/10.1016/j.psychres.2020.113003>
- Zvolensky, M. J., Marshall, E. C., Johnson, K., Hogan, J., Bernstein, A., & Bonn-Miller, M. O. (2009). Relations between anxiety sensitivity, distress tolerance, and fear reactivity to bodily sensations to coping and conformity marijuana use motives among young adult marijuana users. *Experimental and Clinical Psychopharmacology*, 17(1), 31–42. <https://doi.org/10.1037/a0014961>