

EXAMINING THE FACTOR STRUCTURE OF THE SUBSTANCE USE RISK PROFILE
SCALE (SURPS) IN EMERGING ADULTS: AN EXPLORATORY STRUCTURAL
EQUATION MODELLING APPROACH

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A thesis submitted to the Faculty of Graduate Studies in partial fulfillment

of the requirements for the degree of Master of Arts

Graduate Program in Psychology

York University

Toronto, Ontario

April 2025

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Abstract

The Substance Use Risk Profile Scale (SURPS) measures personality traits linked to heavy drinking and related problems (hopelessness, anxiety sensitivity, impulsivity, sensation seeking) and informs personality-matching interventions. The SURPS' factor structure shows inconsistencies, and evidence suggests that confirmatory factor analysis (CFA) is too restrictive for measures capturing correlated constructs. We examined if exploratory structural equation modelling (ESEM) better captured the optimal SURPS factor structure in a large Canadian sample, tested measurement invariance across sex and alcohol use differences, and assessed the predictive validity of SURPS subscales for alcohol use motives and problems. A sample of 6,397 emerging adults completed surveys. ESEM had excellent fit relative to CFA; Item 22 was removed due to a poor factor loading. The final model was invariant across groups; SURPS subscales predicted alcohol use motives and problems. Results support the SURPS' utility for measuring substance use personality risk and ESEM's utility for analyzing correlated constructs.

Dedication

To Cadence Oliver Bennett, without whom I would not have made it this far, in academia or in life. Thank you for always being there for me. Love you s'muchen.

Acknowledgements

I would first like to thank my research supervisor, Dr. Matthew Keough, for both the opportunity to pursue my dreams and for the unwavering stream of support you've given me over the last two (really, seven) years. Thank you for your faith in me and for always staying in my corner. I'd also like to thank my best friends: Cade – you keep me grounded and laughing, and for that I owe you the world, thank you for loving me; Suzanne – I'm lucky to know you, thank you for sticking by my side throughout this wild ride we've put ourselves on. Thank you to my mom, dad, and gran for always believing in me and for supporting me on this journey in each and every way possible; I couldn't do it without you. Finally, I would be remiss if I did not thank both the participants and the funding sources that helped make this work possible. Thank you to all the students across Canada who contributed to this dataset and to the primary funder of this project, the Social Sciences and Humanities Research Council of Canada (SSHRC). The data analyzed in this thesis were collected with support of a SSHRC Partnership Grant [Grant#: 895-2019-1021; PI Stewart], and my work was funded by a SSHRC Canada Graduate Scholarship – Master's award and an Ontario Graduate Scholarship.

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Introduction

Alcohol use is common in Canada – in 2023, over 79.3% of Canadians reported drinking alcohol in the past-year (Government of Canada, 2024). Those within certain developmental phases are at higher risk for heavy alcohol use and related problems than others, however. Emerging adults between the ages of 18-29 years (Arnett et al., 2014) are at particularly elevated risk (Grant et al., 2015), with past-year alcohol use highest among 20-24-year-olds (81.0%; Government of Canada, 2024). Given that emerging adults drink more heavily than those in other phases of development across the lifespan (Health Canada, 2018), it is unsurprising that emerging adults are also at higher risk for alcohol-related problems, including the development of alcohol use disorder (Health Canada, 2024). Due to the high prevalence of drinking among emerging adults and the risks associated with their alcohol use, it is important to develop effective alcohol use prevention and early intervention programs for use with this vulnerable group.

Personality-targeted substance use risk interventions have been developed and validated for use in high school populations (Conrod, 2016; Conrod et al., 2006, 2010, 2013; Edalati & Conrod, 2019; O’Leary-Barrett et al., 2013, 2016; PreVenture, 2024). Canadian universities have begun to recognize the need for similar prevention programming on their campuses, launching personality-targeted research initiatives (Conrod et al., 2022). A common scale used in this work is the Substance Use Risk Profile Scale (SURPS; Woicik et al., 2009). The SURPS measures four personality traits (e.g., hopelessness, anxiety sensitivity, impulsivity, and sensation seeking) that have been linked to heavy drinking, motives for use, and related problems (Woicik et al., 2009). Hopelessness is a proneness to depression characterized by pervasive negative affect, pessimism about the future, and negative thought patterns (Battaglia et al., 2023; Otis et al., 2021; Woicik et al., 2009). Anxiety sensitivity is an anxiety-proneness or “fear of fear” involving beliefs that anxiety sensations can have harmful consequences (Bartel et al., 2018; Mantar et al., 2011;

Stewart, 2024). Impulsivity is an inability to control one's behaviour (i.e., disinhibition) when presented with opportunities for immediate reward, or a rapid response in decision-making with a general lack of forethought for possible negative consequences, especially when emotionally distressed (Battaglia et al., 2023; Keough et al., 2016; Otis et al., 2021; Woicik et al., 2009). Finally, sensation seeking is the desire to have intense, novel, and varied experiences and an increased likelihood for risk-taking to fulfill an excessive need for stimulation (Battaglia et al., 2023; Woicik et al., 2009; Zuckerman, 1994, 2007). The SURPS subscale scores are calculated, and participant's most dominant personality traits are identified. This information is used to match participants to the intervention group that is likely to be most helpful to them personally; thus, it is vital that we ensure the SURPS' psychometric properties are strong in emerging adults as the school-based PreVenture program is extended to this high-risk demographic.

While the SURPS is a popular measure of personality risk with demonstrated utility in emerging adult substance use research (e.g., Chinneck et al., 2018; Lambe et al., 2023; Morris et al., 2023; Yunus et al., 2024), there have been issues identified in the literature regarding its structural validity in multiple samples and across various settings. Most studies have used traditional modelling methods such as confirmatory factor analysis (CFA) to test the SURPS' factor structure. The main issue is that the observed data often do not fit the proposed four-factor model well, with model fit indices typically falling short of currently accepted cut-off standards.¹

¹ Rules of thumb for comparing model fit indices: lower chi-square (χ^2) values suggest better model fit, and $p > .05$ is desirable, reflecting no significant difference between the observed data and the model, meaning that the model fits the data well (Kline, 2016). The χ^2 test is sensitive to large samples, however. Therefore, employing less-sensitive fit indices is encouraged in large sample research (Fan et al., 1999). The Comparative Fit Index (CFI; Bentler, 1990) measures improvements in fit by comparing the indices of a specified model to those of a null model. CFI values range from 0-1.0, where 1.0 is a perfect fit; values above .95 are generally considered excellent fit (Bentler, 1990; Hu & Bentler, 1999; Kline, 2016). Root Mean Square Error of Approximation (RMSEA; Steiger & Lind, 1980) is an absolute fit index assessing the difference between the observed and model-implied covariance matrices while considering model complexity. RMSEA values of 0 reflect perfect model fit; values $\leq .06$ are generally considered acceptable (Browne & Cudeck, 1992; Hu & Bentler, 1999; Kline, 2016). Standardized Root

For instance, the seminal SURPS validation work collected data from American undergraduates and used cross-sample CFA to reveal poor fit on most indices: Sample A: $\chi^2(224) = 407.0$, CFI = .84, RMSEA = .07 and Sample B: $\chi^2(224) = 387.95$, CFI = .88, RMSEA = .06 (Woicik et al., 2009). Similarly poor fit was reported by Blanchard et al. (2020) who tested the SURPS with a four-factor CFA in undergraduates from a southwestern American, mostly-Hispanic-serving university, and Wang and Wang (2021) who conducted a CFA on a Chinese-translated version of the SURPS. CFAs on SURPS data from English, French, and German versions administered to a large European sample (Jurk et al., 2015), a Japanese version given to undergraduates (Omiya et al., 2015), and a Portuguese version given to a Brazilian adult sample (Canfield et al., 2015) all produced poor fit as well. Finally, SURPS data collected from clinical samples in the U.S. (Schlauch et al., 2015) and Lithuania (Kaminskaite et al., 2020) have also produced poor fit indices using four-factor CFAs.

Another central issue is that researchers have tried to artificially improve model fit by making various changes to the four-factor SURPS model. This has been done by evaluating model modification indices (MIs) which provide suggestions for ways to improve fit. MIs recommend select item-factor cross loadings, correlating specific error terms between items, and/or removing items from the model based on subpar factor loadings. For instance, item 16 (“I am interested in experience for its own sake even if it is illegal”) cross-loaded from sensation seeking on to impulsivity in Canadian undergraduate drinkers (Woicik et al., 2009), French-Canadian teens from the community and adolescent patients from a Quebec psychiatric unit

Mean Square Residual (SRMR; Hu & Bentler, 1999) is the standardized difference between observed and predicted correlations; values of 0 indicate perfect fit, but values $< .08$ are generally accepted (Diamantopoulos & Siguaw, 2000; Hu & Bentler, 1999).

(Castonguay-Jolin et al., 2013), American inpatients in an addiction treatment program (Schlauch et al., 2015), and in Australian adolescents (Newton et al., 2016). This finding prompted some to exclude item 16 from analyses (Castonguay-Jolin et al., 2013; Krank et al., 2011; Newton et al., 2016; Schlauch et al., 2015). In the seminal SURPS validation paper, Woicik et al. (2009) examined the proposed four-factor structure in a sample of undergraduate drinkers. MIs suggested mis-specified error covariances for three items of the hopelessness subscale, which, when permitted to covary along with the four factors themselves, produced acceptable data fit: $\chi^2 = 363.74$, CFI = .90, RMSEA = .06 (Woicik et al., 2009). Others have found that errors should be permitted to covary for items 1 and 5 (e.g., “I am content” and “I am happy”) and 9 and 28 (e.g., “I have faith that my future holds great promise” and “I am very enthusiastic about my future”); 28-item SURPS version; Wang & Wang, 2021), and for items 7 and 23 (e.g., “I have faith that my future holds great promise” and “I am very enthusiastic about my future”); 23-item SURPS version; Newton et al., 2016). Regarding low factor loadings, item 22 (impulsivity: “I feel I have to be manipulative to get what I want”) produced a near-zero factor loading in Dutch (Malmberg et al., 2010), Canadian (Krank et al., 2011), and Mexican adolescent samples (Robles-García et al., 2014), as well as emerging adult Spanish (Fernández-Calderón et al., 2017) and Chinese undergraduates (Fan et al., 2023). Seeing as there is no standard method for dealing with MIs, modifications made across studies have been quite inconsistent and largely atheoretical. Taken together, these findings provide support for the idea that CFA may not be the optimal modelling technique to use with SURPS data.

This review of the SURPS structural validation literature reveals problems with poor model fit in various samples and across contexts. These issues of poor fit may largely stem from the use of overly restrictive modelling methods. Traditional CFA precludes any item-factor cross-loadings and correlated errors (Brown, 2006), requiring that each item loads onto only one of the

SURPS subscales. CFA has been criticized for its unrealistic and strict assumption that the factors underlying psychological constructs are completely distinct and uncorrelated (Asparouhov & Muthén, 2009; Marsh et al., 2013). This idealistic structure has repeatedly gone unsupported by the SURPS data, suggesting that CFA fails to capture the nuanced relationships among SURPS items and their underlying constructs. Given these limitations of CFA, and in an effort to better understand the complex personality traits purportedly tapped by the SURPS, exploratory structural equation modelling (ESEM) may present a more suitable approach for analyzing SURPS data. ESEM permits the more realistic scenario of non-zero (i.e., mild-to-moderate) cross-loadings, often resulting in better model fit indices which reflect a more accurate representation of the underlying data structure (Gomez et al., 2020; Kline, 2016; Marsh et al., 2013). ESEM is rooted in the ability to specify a priori hypotheses about the factor structure, including expected item-factor cross-loadings, maintaining the original theoretical basis of the SURPS (Conrod et al., 2000) while allowing its expected structure to shift per the extant SURPS structural validation literature reviewed herein (Kline, 2016; Swami et al., 2023). ESEM estimates the model cross-loadings, constraining them to be as close to zero as possible while still freely estimated, ensuring that primary factor loadings remain prominent to preserve interpretive clarity (Swami et al., 2023).

Recently, Battaglia et al. (2023) tested the factor structure of the SURPS in a Canadian community sample of 400 adults (mean [SD] age = 32.05 [9.78] years), comparing a rigid four-factor CFA with a more contemporary and flexible ESEM model. Their results supported their hypotheses: the CFA showed poor support for the four-factor model: $\chi^2(224) = 894.02$, CFI = .906, RMSEA = .086, SRMR = .08 while the ESEM showed excellent support for the four-factor model: $\chi^2(167) = 444.247$, CFI = .961, RMSEA = .064, SRMR = .038 (Battaglia et al., 2023). Despite the advantages of ESEM, no study has used this analytic tool to test the factor structure

of the SURPS in emerging adults – a high-risk group for heavy drinking and alcohol-related problems in which personality-targeted interventions are now actively being tested (e.g., Conrod et al., 2022). Clarifying the SURPS’ factor structure in this population is crucial for ensuring that evidence-based interventions are as accurate, targeted, and effective as possible. Therefore, building on the results of Battaglia et al. (2023), the first goal of the present study was to contrast CFA with ESEM in examining the optimal factor structure of the SURPS for the first time in the emerging adult demographic; this is the largest sample tested to date in the SURPS psychometric literature. Hypothesis 1 was that our contemporary four-factor ESEM model would produce superior SURPS data fit indices compared to our traditional four-factor CFA model and that our ESEM fit indices would meet the conventional cut-off standards indicative of good model fit.

Furthermore, it is generally considered best-practice to evaluate measures for invariance in different populations to ensure that they measure the intended constructs consistently across groups, increasing confidence that differences observed can be attributed to actual variance in risk profiles instead of biases or measurement errors (American Educational Research Association, 2014; Kline, 2016; Meredith, 1993; Putnick & Bornstein, 2016). SURPS validation studies have found evidence for measurement invariance across gender (Ali et al., 2016; Memetovic et al., 2014), sex and language (Jurk et al., 2015), and age (Ali et al., 2016). In contrast, two studies have shown that the SURPS measured constructs differently across women and men (Blanchard et al., 2020; Kaminskaite et al., 2020). In a Canadian sample of adults, Battaglia et al. (2023) tested the structural invariance of their better-fitting four-factor ESEM SURPS model by gender and age, supporting equivalent SURPS measurement in women and men, and in emerging adult (18-29 years) and adult (30+ years) subsamples. Assuming support for our first hypothesis, our second goal was to test the measurement invariance of the four-factor ESEM SURPS model across biological sex (e.g., females vs. males) and individual differences in

alcohol use (e.g., those below and above the cut-off for problematic alcohol use) in a large sample of Canadian emerging adult undergraduates. If the SURPS is to be used widely, we must know that it is structurally valid for use with different groups of people; thus, our second hypothesis was that the SURPS would be invariant across biological sex and alcohol use groups.

The final goal of this study was to evaluate the utility of the SURPS subscale scores for predicting alcohol use motives and related problems in our large sample of emerging adults. Prior work has shown that the internalizing traits of anxiety sensitivity and hopelessness are strongly related to coping motives for substance use wherein alcohol and/or other drugs are used with the goal of relieving unwanted feelings of distress or other anxiety- and depression-related symptoms (Castellanos-Ryan & Conrod, 2012; Cooper 1994; Cooper et al., 2016). Alcohol use to cope is particularly concerning as this motive has been linked to increased risk for developing alcohol-related problems (Bresin & Mekawi, 2021; Conrod, 2016; Cooper et al., 2016; Woicik et al., 2009). Considering the existing research evidence, we hypothesized that the internalizing traits of anxiety sensitivity and hopelessness, as measured by the SURPS, would significantly predict coping-with-anxiety and coping-with-depression alcohol use motives, and predict alcohol-related problems. On the other hand, the externalizing traits of sensation seeking and impulsivity are strongly related to positive reinforcement motives for substance use, including social and enhancement motives (Battaglia et al., 2023; Castellanos-Ryan & Conrod, 2012; Cooper 1994; Cooper et al., 2016). These motivations for substance use are especially important to emerging adults as they tend to frequent more social environments and be more driven by a desire for novel experiences and excitement; these motives have also been linked to the development of alcohol-related problems (Bresin & Mekawi, 2021; Castellanos-Ryan & Conrod, 2012; Stewart & Devine, 2000; Woicik et al., 2009). Thus, our final hypothesis was that the externalizing traits of

sensation seeking and impulsivity would significantly predict social and enhancement motives for alcohol use and predict alcohol-related problems in our sample of Canadian emerging adults.

Materials & Methods

Participants & Procedures

This study was a secondary analysis of data collected as part of a larger multi-site substance use prevention trial; ethics approval was obtained at all study sites. Self-report cross-sectional survey data collected from a sample of 6,397 emerging adult undergraduate students aged 18-25 years in their first or second year of study from five Canadian postsecondary institutions was used in the present study. The mean [SD] age of the sample was 19.22 [1.49] years, the majority was assigned female at birth (74.3%) and identified as a woman (72.2%) at the time of data collection; see Table 1 for full sample demographics. Participants were recruited through undergraduate research participation pools, on-campus information booths and posters, and electronic communications (e.g., departmental emails, social media advertisements). Prior to completing questionnaires, participants gave electronic informed consent permitting secondary analyses of the associations between survey measures. In compensation for their time, participants received partial credit for an eligible psychology course or a gift card.

Measures

Eligible participants (i.e., aged 18-25 years in their first or second year of study at one of five sites) completed an author-compiled demographics measure to provide data on their sex assigned at birth for testing the structural invariance of the SURPS across sex. Participants also completed a series of validated questionnaires designed to capture their dominant risky personality traits, their motives for alcohol use, and their experience of alcohol-related problems.

Personality Risk Profiles

The 23-item Substance Use Risk Profile Scale (Woicik et al., 2009) was used to assess participants' scores on four personality factors related to heavy drinking: hopelessness, anxiety sensitivity, impulsivity, and sensation seeking. Participants indicated to what extent they agreed with each of the items presented (e.g., "I get scared when I'm too nervous") on a 4-point scale, where response options included 1 = *Strongly Disagree*, 2 = *Disagree*, 3 = *Agree*, 4 = *Strongly Agree*, or 96 = *I prefer not to say* (treated as missing). For the present study, the SURPS was the main focus of psychometric evaluation, and its subscale scores were calculated for use in the predictive validity analyses. Coefficient omega reliability estimates (Flora, 2020; McDonald, 1999) were calculated for each subscale in the present study: 0.861 for hopelessness, 0.721 for anxiety sensitivity, 0.722 for impulsivity, and 0.719 for sensation seeking. See Table 2 for full details of subscale score descriptive statistics.

Alcohol Use Frequency and Hazardous Drinking

The second item of the Co-Venture Drug Use Battery (O'Leary-Barrett et al., 2017) measured participants' alcohol use frequency using a 10-point frequency scale: 1 = *Never*, 2 = *Used in my lifetime, but not in the past 12 months*, 3 = *Used in the past 12 months, but not in the past 3 months*, 4 = *Used in the past 3 months*, 5 = *Monthly or less*, 6 = *2-4 times a month*, 7 = *2-3 times a week*, 8 = *4 times a week or more*, 9 = *4 times or more a day*, 96 = *I prefer not to say* (treated as missing). For scoring, response options were recoded to approximate those of the first item of the Alcohol Use Disorder Identification Test-Consumption (AUDIT-C; Babor et al., 2001; Bush et al., 1998; Saunders et al., 1993): 0 = *Never*, 1 = *Monthly or less*, 2 = *2-4 times per month*, 3 = *2-3 times per week*, 4 = *4 or more times per week*, 96 = *I prefer not to say* (treated as missing). This approximated item was used with AUDIT-C items 2 and 3 to calculate total scores ranging from 0-12 to identify those who met criteria for hazardous drinking, defined by the AUDIT-C cut-offs. Specifically, for men, scores of 4 or more are considered positive for

hazardous drinking or active alcohol use disorders, and for women, scores of 3 or more are considered positive; higher scores are indicative of greater risk. The coefficient omega reliability estimate (Flora, 2020; McDonald, 1999) for the AUDIT-C in the present study was 0.82. See Table 2 for full descriptives.

Alcohol Use Motives

The Brief Alcohol Motives Measure (BAMM; Bartel et al., 2023) consists of six items and was used to assess participant's motivations for alcohol use over the past three months (e.g., enhancement, social, coping-with-anxiety, coping-with-depression, conformity, and expansion of awareness motives). An example (enhancement motive) item reads, "In the past 3 months, I've used alcohol because it enhances positive feelings (e.g., because I like the feeling or to get a high)". Participants could respond to each motive using a visual analog scale ranging from 0 = *Never* to 100 = *Always*; higher scores suggest greater alcohol use frequency driven by that particular motive. The BAMM has strong psychometric properties including test-retest reliability, and content, concurrent, and predictive validity (Bartel et al., 2023). See Table 2 for full descriptives for each motive.

Alcohol-Related Problems

The Brief Young Adult Alcohol Consequences Questionnaire (B-YAACQ; Kahler et al., 2005) consists of 24 items and was used to evaluate the number of alcohol-related problems emerging adults who had ever used alcohol in their lifetime experienced as a result of their use. A sample item reads, "I have driven a car when I knew I had too much to drink to drive safely"; response options included 0 = *No*, 1 = *Yes*, or 96 = *I prefer not to say* (treated as missing). Total scores ranged from 0-24, wherein higher scores indicate more alcohol-related problems; the B-YAACQ has strong psychometric properties including reliability and concurrent validity (Kahler et al., 2005; Read et al., 2006). The coefficient omega reliability estimate was 0.91 in the present

study, showing excellent reliability in this sample of emerging adults (see Table 2 for descriptives).

Statistical Analysis Plan

Cross-site study data were merged and cleaned, and descriptive statistics were obtained using SPSS Statistics version 29 (IBM Corp., 2023). Statistical assumption checks and the following data analyses were conducted using Mplus version 8.10 (Muthén & Muthén, 1998-2011). First, a four-factor CFA and a four-factor ESEM were conducted using a weighted least squares estimator for categorical variables (WLS; Flora & Flake, 2017); goodness-of-fit indices were compared to determine the optimal factor structure of the SURPS using the standard cut-offs of CFI > .95, RMSEA < .06, and SRMR < .08 (Hu & Bentler, 1999; Kline, 2016). Factor loading weights < .40 per Kaminskaite et al. (2020) are considered unacceptable and any low-loading items should generally not be interpreted or included in further analyses. Next, invariance testing was conducted across biological sex and different alcohol use groups. Configural invariance, tested first, examined if the same factor structure emerges across groups; scalar invariance followed, testing if the intercepts of the observed variables (i.e., the expected score on the observed variables when the latent factor is zero) are equal, permitting comparisons of factor means across groups (Bowen & Masa, 2015; Kline, 2016). When using categorical estimators (e.g., WLS), metric invariance is not tested separately – factor loadings are fixed to item thresholds (i.e., the points on the latent trait continuum that separate response options in categorical data) ensuring consistent scaling across groups. This means that scalar invariance tests inherently assess metric invariance (Bowen & Masa, 2015). Chi-square (χ^2) difference tests were reported but given their sensitivity to large samples (i.e., >200; Fan et al., 1999; Kaminskaite et al., 2020) and the large size of the present sample ($N = 6,397$), they were not

considered to be the most valuable metric. Invariance decisions should arguably be made based on a collective evaluation of the other fit indices including ΔCFI , $\Delta RMSEA$, and $\Delta SRMR$, wherein changes of .010, .015, and .015 (for scalar invariance) have traditionally suggested significantly worse model fit, indicative of non-invariance (Battaglia et al., 2023; Chen, 2007; Putnick & Bornstein, 2016; Rutkowski & Svetina, 2014). It is important to note that these cut-offs were developed for CFA which mainly uses continuous variables, and common invariance testing metrics have yet to be thoroughly examined in ESEM, so we are uncertain about if/how they apply to ESEM, especially using categorical variables (Jin, 2020). Nevertheless, until we have specific guidance on cut-offs for ESEM (and especially using categorical indicators), we made use of the prevailing set of guidelines to judge invariance in this study. Lastly, linear regressions tested the validity of the observed scores obtained from the four SURPS subscales for predicting alcohol use motives and alcohol-related problems. Predictive analyses were conducted only for those who reported drinking alcohol in the past three months ($n = 4,214$), as we reasoned that one would need to be a recent drinker to accurately recollect their drinking motives.

Results

Structure of the SURPS: CFA vs. ESEM

Our results support our first hypothesis: the traditional four-factor CFA produced poor SURPS data fit indices, while the contemporary four-factor ESEM produced much superior fit indices in our sample of Canadian emerging adult undergraduates; see Table 3 for full SURPS model fit summary statistics. Examination of the factor loadings of the 23 item SURPS revealed that impulsivity item 22 (“I feel I have to be manipulative to get what I want”) produced low factor loading weights (0.34 in the CFA model; 0.30 in the ESEM model) which are considered unacceptable and uninterpretable (Kaminskaite et al., 2020). Therefore, item 22 was dropped

from the models and analyses were reconducted; Table 4 provides the modified 22-item SURPS CFA and ESEM factor solutions along with inter-factor correlations. Again, the ESEM model produced much superior fit indices compared to the CFA model; all factors were significantly correlated with one another, with coefficients ranging from small-to-moderate in size per traditional guidelines where 0.2 is small, 0.5 is medium, and 0.8 is considered large (Cohen, 1988; 1992). Table 2 offers the means, standard deviations, and coefficient omega reliability estimates for the observed subscale scores of the final 22-item SURPS model (based on primary factor loadings of the ESEM results, which mimicked the original subscales) and other study variables.

Invariance Testing of the SURPS Model

Biological Sex.

Our results generally support our second hypothesis: we tested our baseline model separately in males ($n = 1,620$) and females ($n = 4,751$) and both groups showed good model fit, establishing configural invariance for the SURPS across sex. This means that the overall factor structure is likely the same for males and females. We tested scalar invariance by constraining item intercepts and thresholds to be equal across groups. The model continued to show good fit, indicating that participants with the same level of the latent trait are likely to have the same expected item scores, regardless of their sex assigned at birth. This allows for useful comparisons between the sexes as any differences observed would reflect true differences in the underlying construct rather than measurement bias. When comparing model fit indices across invariance levels (i.e., configural and scalar), we see a statistically significant difference in the chi-square test, but given the size of the present sample, it is the least reliable metric. Evaluation of the less sensitive and more appropriate invariance metrics revealed that RMSEA and SRMR were under

the cut-offs, but CFI was not: $\Delta\chi^2(112) = 743.61, p < 0.001, \Delta CFI = -0.011, \Delta RMSEA = -0.001, \Delta SRMR = 0.003$. This means that, overall, we have found collective evidence in support of configural and scalar invariance for biological sex. Results suggest that the ESEM SURPS subscales likely measure the four personality factors consistently across males and females; see Table 3 for full invariance model fit indices.

Alcohol Use.

As above, our results support our hypothesis: we first tested our baseline model separately in light and heavy drinking groups. Light drinkers ($n = 1,614$) were those who scored below the AUDIT-C cut-off scores, and heavy drinkers ($n = 2,321$) were those who met or exceeded the cut-offs (see Methods). Both groups showed good model fit, establishing configural invariance for the SURPS across different patterns of alcohol use, meaning that the overall structure is likely equivalent across light and heavy drinking groups. Next, we tested scalar invariance and model fit continued to be good, again indicating that those with the same level of the latent trait are likely to have the same expected item scores, regardless of their drinking habits, allowing for meaningful comparisons between drinking level groups. When comparing model fit indices across invariance levels (i.e., configural and scalar), again we see a statistically significant change in the chi-square and CFI, but RMSEA and SRMR were both below their respective cut-offs: $\Delta\chi^2(112) = 559.60, p < 0.001, \Delta CFI = -0.011, \Delta RMSEA = -0.001, \Delta SRMR = 0.003$. This means that, overall, we have found collective evidence in support of configural and scalar invariance for different patterns of alcohol use. Results suggest that the ESEM SURPS subscales likely measure the four personality factors consistently across participants with different alcohol use habits; see Table 3 for full results.

Predictive Validity of the SURPS Subscales

To test the predictive validity of the SURPS subscale scores, they were calculated based on the primary loadings from the 22-item ESEM model. We conducted a single path model where all six alcohol use motives and the alcohol-related problems variable were simultaneously regressed on the four SURPS personality factors, treating alcohol use motives and related problems as correlated outcomes; Table 5 offers the unstandardized and standardized regression coefficients for the alcohol use motives and related problems. Our results mostly support our third hypotheses that the internalizing traits of hopelessness and anxiety sensitivity would significantly predict coping motives and alcohol-related problems. While the other subscales were held constant, the hopelessness subscale significantly positively predicted coping-with-anxiety and coping-with-depression motives, and it also predicted enhancement and conformity drinking motives. The anxiety sensitivity subscale significantly predicted coping-with-anxiety and coping-with-depression motives as hypothesized and also predicted conformity drinking motives. Anxiety sensitivity, but not hopelessness, significantly predicted alcohol-related problems. Finally, we hypothesized that the externalizing traits of impulsivity and sensation seeking would significantly predict social and enhancement motives for alcohol use and alcohol-related problems. While holding the other subscales constant, the impulsivity subscale was a significant positive predictor of social and enhancement motives, and it also predicted coping-with-anxiety, coping-with-depression, conformity, and expansion alcohol use motives. The impulsivity subscale also positively predicted alcohol-related problems, as hypothesized. The sensation seeking subscale significantly predicted social and enhancement motives as hypothesized and also coping-with-depression and expansion motives. Sensation seeking also significantly positively predicted alcohol-related problems in this Canadian emerging adult undergraduate sample. In summary, the internalizing traits and impulsivity predicted all three

negative reinforcement motives, and the externalizing traits predicted all three positive reinforcement motives. The only exceptions to this pattern were significant relationships of hopelessness with enhancement motives and of sensation seeking with coping-with-depression motives. All traits but hopelessness directly predicted alcohol-related problems.

Discussion

This study contributes to the field of personality risk for substance use by providing evidence for the four-factor structure of the SURPS (Woicik et al., 2009) using a contemporary exploratory structural equation modelling (ESEM) approach. We replicated the results of Battaglia et al. (2023) as we also found support for our ESEM model: relative to an ill-fitting traditional CFA model, the ESEM model produced excellent fit indices. We extended upon the work of Battaglia et al. (2023): they tested their model on a sample of 400 Canadian adults, whereas we tested our models on a sample of over 6,300 Canadian emerging adults. This unique demographic is particularly important to focus on as they are the heaviest drinkers and are at higher risk for alcohol-related problems across the lifespan (Government of Canada, 2024; Health Canada, 2018, 2024). Battaglia et al. (2023) also found that their ESEM model was measurement invariant across gender and age; we extended upon this work by examining our SURPS ESEM model for invariance across biological sex and alcohol use differences. Across all evaluated invariance metrics, our results collectively provide support for equal measurement across sexes and light vs. heavy alcohol use groups, again with the caveat that we had to adopt cut-off guidelines from traditional CFA literature, and we are currently unsure of their adaptability to ESEM models. Finally, our results support the predictive validity of the SURPS subscales in assessing vulnerability for risky alcohol use motives and related problems. Regarding motives, hopelessness positively predicted coping-with-anxiety, coping-with-depression, enhancement, and conformity alcohol use motives. Contrasting Battaglia et al. (2023) who found that anxiety

sensitivity did not predict any motive over and above the other SURPS subscales, we found that anxiety sensitivity positively predicted coping-with-anxiety, coping-with-depression, and conformity motives. Impulsivity positively predicted all motives in our emerging adult sample, and sensation seeking positively predicted enhancement, social, coping-with depression, and expansion alcohol use motives. Regarding alcohol-related problems, Battaglia et al. (2023) found that hopelessness, anxiety sensitivity, and sensation seeking all positively predicted alcohol-related problems. We found that all SURPS subscales *except* hopelessness positively predicted alcohol-related problems in this Canadian emerging adult undergraduate sample.

These findings build upon initial validation efforts (Woicik et al., 2009) and expand on other SURPS studies (e.g., Krank et al., 2011; Memetovic et al., 2014; Newton et al., 2016) by making use of a more flexible modeling framework that better accounts for small cross-loadings. Assuming future replication in other samples, the clinical utility of the SURPS will continue to be reinforced by its consistent measurement across important differences such as biological sex and alcohol use patterns (this study), gender (Ali et al., 2016; Battaglia et al., 2023; Memetovic et al., 2014), age (Ali et al., 2016; Battaglia et al., 2023), and language (English, French, German; Jurk et al., 2015), enhancing its application for personalized interventions and risk assessments.

Past research has had difficulty showing good model fit using restrictive confirmatory factor analysis (CFA) methods, wherein items are not allowed to cross-load onto other factors within the scale, even with the help of post-hoc modifications (Blanchard et al., 2020; Canfield et al., 2015; Castonguay-Jolin et al., 2013; Fan et al., 2023; Fernández-Calderón et al., 2017; Jurk et al., 2015; Kaminskaite et al., 2020; Krank et al., 2011; Long et al., 2018; Malmberg et al., 2010; Memetovic et al., 2014; Newton et al., 2016; Omiya et al., 2015; Robles-García et al., 2014; Schlauch et al., 2015; Wang & Wang, 2021; Woicik et al., 2009). Analytic approaches to post-hoc modifications have been variable, quite sample-specific, and largely atheoretical, differing

from study to study and still not providing optimal results. While the SURPS was developed with the intention to measure four distinct personality traits, there is inherent overlap in the constructs in the sense that hopelessness and anxiety sensitivity are both within the same internalizing domain while impulsivity and sensation seeking fall into the externalizing domain (Woicik et al., 2009). As Battaglia et al. (2023) noted, it is difficult to design items that tap into one single construct, so we must recognize that traditional CFA may be too limiting a tool for analyzing overlapping data; ESEM allows us to better capture the picture of what is happening in the scale. Our results support that the ESEM approach is more appropriate for assessing the factor structure of the SURPS in Canadian emerging adults: our ESEM model showed substantially improved fit indices relative to those from our traditional CFA model. Diverging in part from the findings of Battaglia et al. (2023) who found factor loadings of 0.47 (CFA) and 0.36 (ESEM) and converging with the work of others (Castonguay-Jolin et al., 2013; Fan et al., 2023; Fernández-Calderón et al., 2017; Jurk et al., 2015; Kaminskaite et al., 2020; Krank et al., 2011; Malmberg et al., 2010; Omiya et al., 2015; Robles-García et al., 2014), we found evidence that supported the removal of item 22 from the impulsivity subscale of the SURPS as the item did not load strongly onto any of the four factors. It is important to note that the low factor loadings of item 22 likely point to potential issues with the item wording and how impulsivity is commonly conceived of or interpreted. The item reads, “I feel I have to be manipulative to get what I want”, which arguably taps into more antisocial traits than impulsive ones; this possibly helps to explain why we and others have found support for removing the item from the overall scale. Our 22-item ESEM showed superior fit indices than the 22-item CFA.

Next, we tested the measurement invariance of the 22-item SURPS ESEM model across biological sex and individual differences in alcohol use. We argue that invariance should be a collective decision in evaluating changes in χ^2 , CFI, RMSEA, and SRMR between scalar and

configural models. Overall, across all metrics, we found support that the scale is likely invariant, meaning that SURPS scores are likely to have the same meaning across males and females and light and heavy drinkers. These results should be replicated in future research once we have more established guidelines for invariance testing with ESEM using categorical indicators. Working toward ascertaining consistency of measurement across groups helps strengthen the SURPS' clinical utility, as it increases confidence that scores can be reliably used to compare personality risk profiles across these groups. Such invariance could facilitate more effective personalized interventions.

Finally, our study supports the predictive validity of the SURPS subscales for drinking motives and alcohol-related problems, providing empirical evidence to reinforce their value in identifying emerging adults vulnerable to risky alcohol use motives and associated problems. These findings may enable the development or refinement of targeted prevention and early intervention efforts tailored to those with specific personality risk profiles. Clinicians and researchers can use the SURPS subscale scores to design prevention efforts to target problematic motives linked to specific personality profiles. For example, this study is the first to provide evidence that impulsivity and sensation seeking are linked with expansion drinking motives, and the knowledge could be incorporated into future iterations of personality-targeted programming like UniVenture (Conrod et al., 2022). Important to note is that this study did *not* find support for the SURPS hopelessness subscale in predicting alcohol-related problems, inconsistent with past work (Castellanos-Ryan et al., 2013; Krank et al., 2011; Stewart et al., 2011; Woicik et al., 2009). It is possible that our selected measure of alcohol-related problems (i.e., the B-YAACQ; Kahler et al., 2005) does not emphasize the types of alcohol-related problems experienced by undergraduates who are high in hopelessness as measured by the SURPS.

Strengths, Limitations, and Future Directions

This study has several strengths. We evaluated the psychometric properties of the SURPS in a larger, geographically diverse sample of Canadian emerging adult undergraduates, comparing the traditional four-factor CFA model with the more contemporary ESEM approach. Our findings support that the ESEM model produces superior fit due to its greater flexibility in accounting for realistic non-zero cross-loadings (Asparouhov & Muthén, 2009; Brown, 2006). Results extend those of Battaglia et al. (2023) to an undergraduate, emerging adult sample, a population associated with the greatest alcohol use and related problems (Government of Canada, 2024; Grant et al., 2015; Health Canada, 2018, 2024). We also tested measurement invariance across biological sex and light vs. heavy alcohol use patterns, generally finding consistent measurement across both sets of groupings. This supports the SURPS' robustness for group comparisons, ensuring that differences observed reflect true variations in the underlying personality traits rather than measurement bias. We also used an appropriate estimator (WLS) considering our categorical data, further strengthening the accuracy of our findings. The predictive validity of the ESEM-derived SURPS subscales also reinforces confidence in the scale's effectiveness for predicting risky alcohol use motives and alcohol-related problems in emerging adults. Finally, our focus on Canadian emerging adult undergraduates adds valuable insight into personality risk factors for alcohol use in a demographic experiencing unique social-developmental pressures, influencing substance use in a group who are also at high risk for problematic rates of alcohol use and development of alcohol-related problems.

Despite its strengths, this study also has several limitations to consider. One limitation is the need to adapt measurement invariance cut-offs from the CFA literature, which typically uses continuous indicators, not categorical ones like we have here. Since ESEM invariance guidelines are less established, we relied on CFA standards that may not fully capture the complexity of categorical data. Future psychometric work on the SURPS should replicate our findings using

more tailored ESEM invariance criteria as they are developed and become available. Our sample also consisted only of undergraduate students from across Canada, which may limit the generalizability of our findings to other emerging adult populations elsewhere, other age groups, or the broader general population. Future research should examine the SURPS across diverse educational and occupational groups, for example, to enhance generalizability and validity across various groups. Our cross-sectional design also limits causal interpretations of the relationships between personality traits, alcohol use motives, and alcohol-related outcomes, so future research should involve longitudinal designs to provide greater insight into the predictive validity of the SURPS over time.

Conclusion

This study provides evidence supporting the four-factor ESEM model of the SURPS and supports the measurement invariance of the SURPS across biological sex and alcohol use patterns. These findings highlight the SURPS' value as a reliable and structurally valid instrument for assessing personality vulnerability factors associated with risky alcohol use motives and alcohol-related problems in Canadian emerging adult undergraduates. Limitations related to the lack of sample diversity, item performance, and the cross-sectional study design warrant further investigation. Future research should aim to explore the predictive validity of the SURPS using a longitudinal design with undergraduates to optimize its utility in both clinical and research contexts.

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Tables

Table 1

Participant Demographics

Variable	<i>M</i> [SD] or <i>n</i> (%)
Age	19.22 [1.49]
Biological sex assigned at birth	
Male	1,620 (25.3%)
Female	4,754 (74.3%)
Missing	23 (0.4%)
Gender identity	
Man	1,600 (25.0%)
Woman	4,617 (72.2%)
Transgender	23 (0.4%)
Non-binary	109 (1.7%)
Two-spirit	6 (0.1%)
Other	25 (0.4%)
Missing	17 (0.3%)
Year of study	
First	3,945 (61.7%)
Second	2,452 (38.3%)
Employment	
No	3,257 (50.9%)
Yes, part-time	2,673 (41.8%)
Yes, full-time	369 (5.8%)
Missing	98 (1.5%)
Province	
British Columbia	1,770 (27.7%)
Ontario	1,717 (26.8%)
Quebec	896 (14.0%)
Nova Scotia	2,014 (31.5%)

Note. *M* = mean, SD = standard deviation.

Table 2*Descriptive Statistics*

Measure	<i>M</i>	SD	Range	Omega (ω)
Personality risk profiles (SURPS)				
Hopelessness	1.99	0.54	1-4	0.861
Anxiety Sensitivity	2.75	0.57	1-4	0.721
Impulsivity	2.22	0.55	1-4	0.722
Sensation Seeking	2.67	0.61	1-4	0.719
Hazardous alcohol use (AUDIT-C)	3.63	2.66	0-12	0.82
Alcohol use motives (BAMM)				
Enhancement	50.93	32.12	0-100	–
Social	67.87	27.90	0-100	–
Coping-with-anxiety	31.53	32.00	0-100	–
Coping-with-depression	24.25	30.23	0-100	–
Conformity	32.06	31.60	0-100	–
Expansion of awareness	16.69	24.10	0-100	–
Alcohol related problems (B-YAACQ)	6.32	5.17	0-24	0.91

Note. *M* = mean, SD = standard deviation; SURPS = Substance Use Risk Profile Scale (Woicik et al., 2009); AUDIT-C = Alcohol Use Disorder Identification Test-Consumption (Babor et al., 2001; Bush et al., 1998; Saunders et al., 1993); BAMM = Brief Alcohol Motives Measure (Bartel et al., 2023); B-YAACQ = Brief Young Adult Alcohol Consequences Questionnaire (Kahler et al., 2005); BAMM scales are single items so no omega values are provided.

Table 3*Model Fit Summary Statistics*

Model	χ^2	<i>df</i>	CFI	RMSEA [90% CI]	SRMR
Four-Factor CFA (all 23 items)	5,927.23	224	0.890	0.063 [0.062, 0.064]	0.075
Four-Factor CFA (item 22 removed)	5,414.18	203	0.898	0.063 [0.062, 0.065]	0.073
Four-Factor ESEM (all 23 items)	2,489.10	167	0.955	0.047 [0.045, 0.048]	0.044
Four-Factor ESEM (item 22 removed)	2,199.80	149	0.960	0.046 [0.045, 0.048]	0.043
Biological Sex Invariance					
Male	676.50	149	0.966	0.047 [0.043, 0.051]	0.052
Female	1,752.46	149	0.959	0.048 [0.046, 0.050]	0.047
Sex Configural	2,428.98	298	0.961	0.048 [0.046, 0.050]	0.048
Sex Scalar	3,172.59	410	0.950	0.047 [0.045, 0.048]	0.051
Drinking Group Invariance					
Below AUDIT-C Cut-off	734.18	149	0.964	0.049 [0.046, 0.053]	0.053
Above AUDIT-C Cut-off	1,018.63	149	0.961	0.050 [0.047, 0.053]	0.050
AUDIT Category Configural	1,752.81	298	0.962	0.050 [0.048, 0.052]	0.051
AUDIT Category Scalar	2,312.41	410	0.951	0.049 [0.047, 0.050]	0.054

Note. $p < .001$ for all χ^2 tests; *df* = degrees of freedom; CFI = comparative fit index; RMSEA = root mean square error of approximation; CI = confidence interval; SRMR = standardized root mean square residual; CFA = confirmatory factor analysis; ESEM = exploratory structural equation model. Invariance was tested on the adjusted 22-item ESEM SURPS model.

Table 4*Factor Solution for the SURPS in Emerging Adults: Four-Factor CFA and ESEM Solutions and Inter-Factor Correlations*

Item	Four-Factor CFA					Four-Factor ESEM				
	H	AS	IMP	SS	R^2	H	AS	IMP	SS	R^2
1. I am content. (R)	0.80				0.65	0.86	0.05	-0.17	0.17	0.70
4. I am happy. (R)	0.91				0.83	0.94	0.07	-0.14	0.18	0.85
7. I have faith that my future holds great promise. (R)	0.84				0.71	0.78	-0.11	0.12	-0.25	0.74
13. I feel proud of my accomplishments. (R)	0.71				0.51	0.72	-0.10	0.09	-0.11	0.55
17. I feel that I'm a failure.	0.74				0.54	0.66	0.19	0.18	0.06	0.60
20. I feel pleasant. (R)	0.80				0.64	0.84	0.04	-0.07	0.05	0.68
23. I am very enthusiastic about my future. (R)	0.87				0.76	0.83	-0.12	0.08	-0.19	0.77
8. It's frightening to feel dizzy or faint.		0.63			0.39	-0.12	0.64	-0.02	-0.11	0.42
10. It frightens me when I feel my heart beat change.		0.70			0.48	-0.04	0.71	0.03	-0.06	0.52
14. I get scared when I'm too nervous.		0.62			0.39	0.11	0.62	0.04	-0.05	0.44
18. I get scared when I experience unusual body sensations.		0.73			0.53	0.01	0.74	0.01	-0.08	0.56
21. It scares me when I am unable to focus on a task.		0.44			0.19	0.07	0.51	0.03	0.11	0.28
2. I often don't think things through before I speak.			0.68		0.46	-0.04	-0.07	0.73	0.09	0.49

5. I often involve myself in situations I later regret being involved in.	0.50	0.25	0.17	0.15	0.47	0.07	0.5
11. I usually act without stopping to think.	0.83	0.68	-0.03	0.00	0.84	0.03	0.72
15. Generally, I am an impulsive person.	0.72	0.52	-0.03	0.07	0.59	0.28	0.53
3. I would like to skydive.	0.65	0.43	0.00	-0.09	-0.02	0.66	0.45
6. I enjoy new and exciting experiences even if they are unconventional.	0.62	0.39	-0.19	0.01	0.07	0.60	0.44
9. I like doing things that frighten me a little.	0.72	0.51	-0.04	-0.06	0.07	0.71	0.55
12. I would like to learn how to drive a motorcycle.	0.48	0.23	0.06	-0.04	0.03	0.52	0.28
16. I am interested in experience for its own sake even if it is illegal.	0.64	0.41	0.13	-0.08	0.23	0.51	0.40
19. I would enjoy hiking long distances in wild and uninhabited territory.	0.46	0.21	-0.04	-0.01	-0.03	0.51	0.26

Factor Correlations	Four-Factor CFA				Four-Factor ESEM			
	H	AS	IMP	SS	H	AS	IMP	SS
H	--				--			
AS	0.23**	--			0.16**	--		
IMP	0.18**	0.03*	--		0.22**	0.13**	--	
SS	-0.07**	-0.27**	0.51**	--	-0.13**	-0.08**	0.31**	--

Note. H = Hopelessness; AS = Anxiety Sensitivity; IMP = Impulsivity; SS = Sensation Seeking; R = reverse scored item. The primary factor loadings are in bold. * = $p < .05$, ** = $p < .001$. Factor solutions and inter-factor correlations provided for the adjusted 22-item SURPS models.

Table 5*Predictive Validity for the SURPS in Emerging Adults: Alcohol Use Motives and Related Problems*

Personality Risk	B	SE	Z	p	β	B	SE	Z	p	β
Factors (SURPS										
subscales)	Enhancement alcohol use motive					Social alcohol use motive				
Hopelessness	0.372	0.165	2.259	0.024	0.046	-0.066	0.139	-0.476	0.634	-0.010
Anxiety Sensitivity	-0.183	0.220	-0.831	0.406	-0.017	0.349	0.185	1.884	0.060	0.039
Impulsivity	1.166	0.232	5.017	< 0.001	0.105	0.592	0.196	3.020	0.003	0.064
Sensation Seeking	0.613	0.182	3.371	0.001	0.070	0.302	0.153	1.975	0.048	0.041
<i>Intercept</i>	30.791	5.041	6.108	< 0.001	1.024	56.571	4.246	13.322	< 0.001	2.248
<i>R</i> ²	0.024	0.006	4.009	< 0.001		0.008	0.004	2.308	0.021	
	Coping-with-anxiety alcohol use motive					Coping-with-depression alcohol use motive				
Hopelessness	1.635	0.171	9.552	< 0.001	0.188	1.712	0.159	10.738	< 0.001	0.208
Anxiety Sensitivity	1.290	0.229	5.641	< 0.001	0.111	0.809	0.213	3.808	< 0.001	0.074
Impulsivity	1.772	0.242	7.334	< 0.001	0.148	2.160	0.225	9.617	< 0.001	0.192
Sensation Seeking	0.293	0.189	1.551	0.121	0.031	0.450	0.176	2.565	0.010	0.051
<i>Intercept</i>	-30.894	5.237	-5.899	< 0.001	-0.951	-41.509	4.867	-8.529	< 0.001	-1.358
<i>R</i> ²	0.094	0.011	8.533	< 0.001		0.117	0.012	9.806	< 0.001	
	Conformity alcohol use motive					Expansion alcohol use motive				

Hopelessness	0.598	0.171	3.488	< 0.001	0.070	-0.060	0.135	-0.441	0.659	-0.009
Anxiety Sensitivity	1.449	0.230	6.310	< 0.001	0.127	0.179	0.181	0.989	0.322	0.020
Impulsivity	1.937	0.242	8.015	< 0.001	0.165	1.161	0.190	6.096	< 0.001	0.128
Sensation Seeking	-0.191	0.189	-1.012	0.312	-0.021	0.576	0.149	3.868	< 0.001	0.081
<i>Intercept</i>	-14.428	5.247	-2.750	0.006	-0.453	-6.406	4.135	-1.549	0.121	-0.260
<i>R</i> ²	0.060	0.009	6.600	< 0.001		0.028	0.006	4.339	< 0.001	
Alcohol-related problems										
Hopelessness	0.024	0.026	0.929	0.353	0.018					
Anxiety Sensitivity	0.093	0.034	2.689	0.007	0.051					
Impulsivity	0.514	0.037	14.045	< 0.001	0.274					
Sensation Seeking	0.154	0.028	5.430	< 0.001	0.105					
<i>Intercept</i>	-1.947	0.783	-2.487	0.013	-0.383					
<i>R</i> ²	0.107	0.011	9.523	< 0.001						

Note. B = unstandardized regression coefficient, SE = standard error, β = standardized regression coefficient, SURPS = Substance Use Risk Profile Scale (Woicik et al., 2009); BAMB = Brief Alcohol Motives Measure (Bartel et al., 2023); B-YAACQ = Brief Young Adult Alcohol Consequences Questionnaire (Kahler et al., 2005). Predictive analyses were conducted with the adjusted 22-item ESEM SURPS model.