Reexamining the Psychometric Properties of the Substance Use Risk Profile Scale

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Abstract

The Substance Use Risk Profile Scale (SURPS), a widely used self-report questionnaire, assesses four personality traits which predict risk for substance use (i.e., anxiety sensitivity, hopelessness, impulsivity, and sensation seeking). Given its use in research and clinical settings, as well as potential utility, this study aimed to provide a comprehensive psychometric evaluation of the SURPS. Undergraduate participants ($N = 718$; 69% White; 26% Hispanic, aged 18-25 years, $M = 19.00$, $SD = 1.33$) completed a battery of measures, including the SURPS. Tests of measurement invariance, convergent and criterion validity, and internal consistency were conducted, as well as item response theory analyses and a treatment assignment simulation. Several items were removed before partial measurement invariance across gender was established with little information lost. Despite removing several SURPS items, the proposed factor structure was not empirically supported. More work is necessary to determine the predictive utility of assessing these personality traits to predict substance-related outcomes.

Keywords

SURPS, substance use, personality, item response theory, measurement invariance, psychometrics

The predictive utility of personality traits regarding engagement in alcohol and substance use behaviors, as well as risk for problematic substance use, is well-documented (e.g., Caspi, Moffitt, Newman, & Silva, 1996; Cloninger, 1987; Kotov, Gamez, Schmidt, & Watson, 2010; Littlefield & Sher, 2016; Sher, Bartholow, & Wood, 2000). In an effort to harness this clinical utility, the Substance Use Risk Profile Scale (SURPS) was developed to assess personality traits associated with elevated risk for problematic substance involvement (Conrod, Comeau, Stewart, Maclean, & Woicik, 2002; Woicik, Stewart, Pihl, & Conrod, 2009). The SURPS is a widely used 23-item self-report questionnaire purported to discern risk for substance use as a function of four personality traits (i.e., anxiety sensitivity [AS], hopelessness [H], impulsivity [IMP], and sensation seeking [SS]). In line with motivational models of alcohol and substance use (e.g., Cooper, 1994; Cooper, Frone, Russell, & Mudar, 1995; Cox & Klinger, 1988, 1990), individuals endorsing increased IMP and/or SS are thought to seek the positive reinforcement properties of substance use (e.g., increased relaxation and euphoria; Green, Kavanagh, & Young, 2003). Conversely, individuals endorsing increased AS and/or H are thought to be motivated by the negatively reinforcing properties of substance use (e.g., anxiolytic effects; McCabe, Cranford, Boyd, & Teter, 2007). In clinical and research settings, the SURPS is used to assign individuals to a specific personality-targeted treatment based on their SURPS profile (e.g., Castellanos & Conrod, 2006; Conrod, Castellanos,

& Mackie, 2008; Conrod, Stewart, Comeau, & Maclean, 2006; Mushquash, Comeau, & Stewart, 2007). Importantly, evidence suggests personality-targeted efforts may be effective in reducing likelihood to use alcohol, binge drink, and experience associated consequences among high-risk adolescents. The SURPS has also been used in substance-related intervention research (e.g., motivational alcohol interventions; Kazemi, Levine, Dmochowski, Van Horn, & Qi, 2015), national multisite secondary school prevention studies (Malmberg et al., 2010; Malmberg et al., 2015), and in one of the largest longitudinal, multinational genetic and neuroimaging studies to date (O'Leary-Barrett et al., 2017), as well as multiple neuropsychological studies (e.g., Liggins, Pihl, Benkelfat, & Leyton, 2012; Pripfl, Neumann, Köhler, & Lamm, 2013; Setiawan et al., 2014; Whelan et al., 2014).

Not only is the SURPS used in substance use research in the United States, the SURPS has also been used worldwide, including countries like Hong Kong (Siu, 2010)

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Germany, Ireland, France, the United Kingdom (Jurk et al., 2015), The Netherlands (Malmberg et al., 2012), Sri Lanka (Chandrika Ismail, De Alwis Seneviratne, Newcombe, & Wanigaratne, 2009), Brazil (Canfield, Gilvarry, & Koller, 2014). Australia, The Republic of Korea (Saliba, Moran, & Yoo, 2014), and Canada (Barnes, Cea, Baker, Holroyd, & Stockwell, 2014; Mushquash, Stewart, Mushquash, Comeau, & McGrath, 2014). This measure has also been translated into several languages, including Spanish (Fernández-Calderón, Díaz-Batanero, Rojas-Tejada, Castellanos-Ryan, & Lozano-Rojas, 2017; Robles-García et al., 2014), Brazilian Portuguese (Canfield et al., 2014), French (O'Leary-Barrett et al., 2017), Dutch (Malmberg et al., 2010), Chinese (Siu, 2010; D. Wang, Hu, Zheng, & Liu, 2017), Japanese (Omiya, Kobori, Tomoto, Igarashi, & Iyo, 2015), Korean (Saliba et al., 2014), and Sinhalese (Chandrika Ismail et al., 2009). Furthermore, the SURPS has been used for evaluations of convergent validity for other measures, such as drinking motives assessments (Hudson, Wekerle, & Stewart, 2014; Mushquash et al., 2014) and translated IMP measures (D. Wang et al., 2017).

Much work has examined correlations between SURPS subscales and substance use outcomes, such as alcohol, tobacco, and cannabis use, as well as related problems, among adolescents (Battista, Pencer, McGonnell, Durdle, & Stewart, 2013; Lammers, Kuntsche, Engels, Wiers, & Kleinjan, 2013; Malmberg et al., 2012; Malmberg et al., 2015; Moser, Pearson, Hustad, & Borsari, 2014) and college students (Barnes et al., 2014; Hustad, Pearson, Neighbors, & Borsari, 2014; Mackinnon, Kehayes, Clark, Sherry, & Stewart, 2014). For example, SS was found to be positively associated with peak blood alcohol content, and H with alcohol problems among college students (Moser et al., 2014). Among high school students, Malmberg et al. (2012) found positive associations between H with alcohol and tobacco use, IMP with tobacco and cannabis use, and SS with alcohol, tobacco, and cannabis use. Other studies, however, have found negative associations between AS and alcohol use (Malmberg et al., 2010; Moser et al., 2014), and others have found no significant relations between H, IMP, or SS with alcohol or substance use outcomes (e.g., lifetime tobacco use; Omiya et al., 2015). Although Canfield et al. (2014) found H and AS to be associated with alcohol consumption, IMP and SS were not, contrary to the larger literature on impulsive dispositions (e.g., Littlefield & Sher, 2010; Magid, MacLean, & Colder, 2007); moreover, SS was only associated with cannabis use, AS was only associated with sedative use, and no subscale was significantly related to stimulant use (Canfield et al., 2014). In sum, previous work demonstrates equivocal relations between SURPS subscales and substance-related outcomes.

Prior Psychometric Studies of the SURPS

Although there have been several psychometric evaluations of the SURPS, these evaluations are limited in several ways. In the original studies, Woicik et al. (2009) reported questionable-to-acceptable fit to the four-factor model (derived from principal components analyses; comparative fit index [CFI] = .89-.90, root mean square error of approximation [RMSEA] = .05-.06), after post hoc modifications (i.e. correlating residuals on H items). Since then, replication studies have often followed a similar pattern, justifying post hoc modifications to the factor structure, or proceeding despite inadequate model fit (e.g., Omiya et al., 2015; Schlauch, 2010). Perhaps even more problematic is that examinations of psychometric properties are often conducted on modified models (e.g., items removed, error covariances estimated) which are not replicated across studies and do not comport with typical use in clinical and research settings. For example, tests of measurement invariance are often conducted on these study-specific factor structures. Because this psychometric foundation is necessary to compare SURPS subscale scores across groups and draw accurate conclusions, a thorough examination of this psychometric property on the scale as used is warranted.

Measurement invariance has been tested on the SURPS, and some evidence suggests the SURPS is gender invariant. More specifically, Jurk et al. (2015) reported "SURPS items worked relatively identical in males and females" (p. 2244). Memetovic, Ratner, and Richardson (2014) also found measurement invariance across gender in a sample of adolescents. However, in addition to the use of a atheoretical factor structures with post hoc modifications, some analytic approaches used may be suboptimal (e.g., use of ΔCFI and ΔRMSEA with ordinal indicators, rather than the recommended DIFFTEST option in M*plus*; L. K. Muthén & Muthén, 1998-2017). Although evidence exists in support of the SURPS' measurement invariance, this support is only provided for post hoc modified models, which is potentially problematic.

Despite some strengths of previous SURPS psychometric validation efforts (e.g., testing measurement invariance; Jurk et al., 2015; Memetovic et al., 2014), additional psychometric testing is needed. For example, correlating residual error terms to achieve adequate model fit is problematic, as it violates the assumption of tau-equivalence for congeneric models (Lucke, 2005), particularly when error terms are correlated for different item pairs across studies (which appears to be the case in the extant literature). This may be due, in part, to use of modification indices (i.e., software-generated suggestions for improving model fit). Reliance on modification indices to determine correlated error terms is suboptimal, as these alterations are atheoretical. Furthermore, model respecifications of this kind often improve model fit but can mask significant relations in the

model and/or may indicate an omitted variable from the model (see Hermida, 2015; c.f., Hopwood & Donnellan, 2010) both of which can lead to erroneous specifications and may yield erroneous conclusions. Because previous validation efforts have largely been unable to demonstrate adequate model fit without post hoc modifications prior to examining psychometric properties (e.g., measurement invariance), limitations remain.

Overall, evidence supporting the psychometric validity of the proposed four-factor structure of the SURPS is inconsistent at best. Moreover, and surprisingly, some key psychometric properties of the SURPS have yet to be evaluated. For example, to our knowledge, there is no item response theory (IRT) examination of the SURPS, despite its widespread use across diverse areas of research. Additionally, evidence for internal consistency of the SURPS is also inconsistent. Cronbach's alpha estimates yield broad ranges across studies (e.g., from .60 [SS] to .79 [H]; Jurk et al., 2015; from .63 [AS] to .91 [H]; Krank et al., 2011), which range from questionable-to-excellent. Although H consistently demonstrated the highest internal consistency, this may be a function of more items on this subscale (Nunnally, 1978; Sijtsma, 2009). Thus, psychometrically, the SURPS has modest support for its reliability.

In part, reflecting the recognition that many existing scales used in psychological research have not undergone adequate psychometric scrutiny (see Borsboom, 2006), there have been several recent efforts to (re)evaluate psychometric properties of widely used personality scales (e.g., Reise, Moore, Sabb, Brown, & London, 2013; Steinberg, Sharp, Stanford, & Tharp, 2013). Consistent with these efforts, similar SURPS work (e.g., Jurk et al., 2015; Krank et al., 2011; Memetovic et al., 2014; Schlauch et al., 2015; Woicik et al., 2009), and in line with seminal psychometric recommendations (see Campbell & Fiske, 1959), the purpose of this study was to reevaluate the psychometric properties (i.e., factor structure, internal consistency reliability, convergent validity, discriminant validity, concurrent criterion validity, and measurement invariance across gender) of the SURPS. More specifically, we sought to evaluate the SURPS using its original four-factor structure while modeling the items as ordinal and without correlating residuals. Although exploratory confirmatory factor analyses (CFAs), which sometimes include cross-loading items and/or subscales (e.g., Wright et al., 2012) have gained popularity, our purpose is to examine the simple structure of the SURPS (i.e., no cross-loading items, no correlated residual variance) to assess the measure as it is used in most clinical contexts (i.e., summed subscale scores).

Additionally, we also aimed to include multiple tests of reliability and validity, consistent with similar SURPS evaluations (e.g., Jurk et al., 2015; Krank et al., 2011; Memetovic et al., 2014; Schlauch et al., 2015; Woicik et al., 2009). Furthermore, given the SURPS assumes IMP is unidimensional, which has largely been refuted in the extant literature (see Cyders, 2015), we hoped providing correlations between the SURPS and UPPS-P, a measure of impulsive dispositions, would be useful to determine which facet(s) the SURPS IMP scale may be measuring. We are the first, to our knowledge, to assess measurement invariance using currently recommended practices (L. K. Muthén & Muthén, 1998-2017; Sass, 2011). Moreover, this is the first study (to our knowledge) to examine the SURPS using an IRT framework, which is also consistent with recent psychometric reevaluation efforts (see Steinberg et al., 2013). We also aimed to use both contemporary (i.e., coefficient omega) and traditional psychometric approaches (i.e., coefficient alpha) to balance criticisms of coefficient alpha (e.g., Dunn, Baguley, & Brunsden, 2014; Graham, 2006; Sijtsma, 2009) while acknowledging its widespread use. Treatment assignment simulations were also conducted to examine the SURPS' capacity for its intended use. Due to the exploratory psychometric nature of this comprehensive evaluation, no formal hypotheses were proffered.

Method

Participants and Procedures

Undergraduate participants ($N = 718$) were recruited from a large, Southwestern, Hispanic-serving university enrolled in introductory psychology courses. Mean participant age was 19.00 years ($SD = 1.33$), and most self-identified as female (66%) and White (68%), with a minority self-identifying as Hispanic/Latinx (26%). All participants completed a large battery of demographic questions and self-report measures online. These procedures and measures were approved by the university's institutional review board, and participants received research course credit as compensation.

Measures

Demographics. Participants were asked to self-report demographic information including self-identified age, gender, sexual orientation, race, and ethnicity.

Alcohol and Substance Use. Past-month alcohol and substance use was assessed using select items from the American Drug and Alcohol Survey (ADAS; Rocky Mountain Behavioral Science Institute, 2003). Past-month frequency of intoxication was assessed using the following item: "How often in the last month have you gotten drunk?" with response options of (0) *none*, (1) *1-2*, (2) *3-9*, (3) *10-19*, and (4) *20 or more times* in the past month. Alcohol-related problems were assessed via a continuous 15-item measure of total problems endorsed ($\alpha = .86/\omega = .88$, 95% confidence interval [95% CI: .85, .90]). Past-month depressant use was assessed via endorsement of past-month tranquilizer use

(e.g., Valium®, Librium®, Xanax®), barbiturate use (e.g., downers, phenobarbital, Seconal®, reds, yellows, etc.), and/or narcotic use (e.g., narcotic other than heroin [codeine, Demerol®, methadone, Talwin®, opium, and morphine]), and was transformed into a binary item given the relatively low endorsement of frequent past-month depressant use (<10% of sample). Past-month stimulant use was also transformed into a binary item. Past-month cigarette and smokeless tobacco use were assessed, separately, using binary response options. All binary responses were coded such that "1" reflected substance use endorsement.

Anxiety Sensitivity. Anxiety sensitivity (distinct from the SURPS' AS) was assessed using the 18-item self-report Anxiety Sensitivity Index–3 (ASI-3; Taylor et al., 2007). Participants selected which number on a 5-point Likert-type scale best described his or her behavior with higher total scores reflecting higher anxiety sensitivity ($\alpha = .90/\omega = .90$, 95% CI [.88, .91]).

Depression. Depressive affect was assessed using the shortened, eight-item version of the self-report Center for Epidemiologic Studies–Depression Scale (CES-D; Radloff, 1977; Santor & Coyne, 1997). Participants selected which number on a 4-point Likert-type scale best described his or her feelings and experiences during the past week. Higher scores reflect increased depressive affect ($\alpha = .87/\omega = .88$, 95% CI [.86, .90]).

Hopelessness. Hopelessness was assessed using the 12-item self-report Herth Hope Index (HHI; Herth, 1992). Participants selected the extent to which they agreed with each statement (e.g., "I feel scared about my future") on a 4-point Likert-type scale with higher total scores reflecting more hopelessness ($\alpha = .87/\omega = .87$, 95% CI [.86, .89]).

Impulsivity-Like Traits. Impulsigenic traits (i.e., positive urgency, negative urgency, sensation seeking, lack of planning, and lack of perseverance) were assessed using the 59-item self-report UPPS-P Impulsive Behavior Scale (Lynam, Smith, Cyders, Fischer, & Whiteside, 2007). Participants selected which number on the 4-point Likert-type scale best described his or her behavior with higher subscale sum scores reflecting higher impulsigenic traits ($\alpha = .82$-94/positive urgency $\omega = .87$, 95% CI [.86, .89]); negative urgency $\omega = .88$, 95% CI [.87, .90]; SS $\omega = .87$, 95% CI [.86, .89], lack of planning $\omega = .82$, 95% CI [.80, .84], lack of perseverance $\omega = .82$, 95% CI [.80, .84]).

Substance Use Risk. Propensity for substance use was assessed using the 23-item self-report SURPS; Woicik et al., 2009). Participants reported the extent to which they agreed with each statement on a 4-point Likert-type scale. Higher subscale sum scores (i.e., five-item AS, seven-item

H, five-item IMP, six-item SS) reflect increased risk ($\alpha = .71$-.85; see Results for omegas).

Analytic Strategy

Given the comprehensive nature of this work, we have divided the analytical procedure and results into two parts. Part 1 includes evaluation of the SURPS four-factor structure and measurement invariance testing across gender. Part 2 includes SURPS refinement via IRT analyses, reliability and validity analyses for the original and refined SURPS scales, and treatment assignment simulation analyses.

Part 1

Exploratory data analyses were conducted to assess for normality. All continuous variables were normally distributed (i.e., skewness and kurtosis approximately between −1.00 and +1.00; Fox, 2008). Response categories were rescaled for past-month frequency of alcohol intoxication (i.e., "How often in the last month have you gotten drunk?") and past-month cannabis use ("How often in the last month have you used marijuana?") such that low (i.e., <10% of the sample) endorsement response categories were collapsed. Rescaled response options resulted in four response options for past-month frequency of alcohol intoxication (i.e., "none," "1-2 times," "3-9 times," and "10 or more times") and three response options for past-month marijuana use (i.e., "none," "1-2 times," and "3 or more times").[1] All data management and coding were conducted using SAS 9.4™ software (SAS Institute Inc., 2010, Cary, NC, USA).[2]

Measurement Invariance. All structural equation modeling (SEM), including CFAs and tests of measurement invariance, were conducted in M*plus* 7.11 (L. K. Muthén & Muthén, 1998-2017) using weighted least squares means and variances adjusted and delta parameterization to properly model ordinal, Likert-type items (Asparouhov & Muthén, 2010; B. O. Muthén & Satorra, 1995). Without establishing measurement invariance, gender differences in endorsement of SURPS subscales may not be due to true gender differences in subscale scores. If this is the case, substantive questions cannot be accurately addressed, as raw scores may be influenced by irrelevant gender-specific attributes and lead to inaccurate conclusions (see J. Wang & Wang, 2012).

First, the four-factor structure of the SURPS was tested. Configural, scalar, and partial scalar invariance were tested with multigroup categorical CFA models for the overall four-factor structure and each separate SURPS subscale (see Millsap & Yun-Tein, 2004, for an overview of measurement invariance). To establish configural invariance,

Table 1. Descriptive Statistics.

Variable	M or n	SD or %	Minimum	Maximum
Age	19.01	1.33	18	25
Freshmen	478	67%		
Female	476	66%		
AS	12.25	2.75	5	20
H	12.63	3.67	18	67.5
Imp	10.45	2.83	5	20
SS	16.12	3.57	6	24
Revised AS	6.93	1.82	3	12
Revised H	8.91	2.73	5	20
Revised Imp	8.45	2.46	4	16
Revised SS	7.93	1.85	3	12
Anxiety sensitivity index	44.41	12.97	18	90
Herth hope index	32.38	8.53	18	67.5
UPPS-P PU	27.31	9.17	14	56
UPPS-P NU	27.66	7.08	12	46
UPPS-P SS	34.41	6.96	12	48
UPPS-P LPer	19.28	4.75	10	34
UPPS-P LPlan	21.50	4.93	11	44
Alcohol problems	2.19	3.00	0	14
PM alcohol intoxication	0.86	0.97	0	3
PM cannabis use	0.43	0.74	0	2
PM cigarette use	139	19%		
PM smokeless tobacco use	56	8%		
PM depressant use	30	4%		
PM stimulant use	60	8%		

Note. AS = anxiety sensitivity; H = hopelessness; IMP = impulsivity; SS = sensation seeking; UPPS-P PU = positive urgency; UPPS-P NU = negative urgency; UPPS-P SS = sensation seeking; UPPS-P LPer = lack of perseverance; UPPS-P LPlan = lack of planning; PM = past-month. Sample size (*n*) and frequency (%) reported for categorical variables (i.e., class status, gender, PM cigarette, PM smokeless tobacco, PM depressant, and PM stimulant).

model fit was tested across males and females when no equality constraints were imposed (see J. Wang & Wang, 2012). These configural models served as the comparison model in all subsequent tests of scalar invariance. To test for scalar invariance (i.e., factor loadings and thresholds), the configural model was compared with a more constrained model (see Stevens, Blanchard, Shi, & Littlefield, 2017 for modeling details). For subscales that did not demonstrate scalar invariance, multigroup CFA models were tested for partial scalar invariance by removing equality constraints from factor loadings and thresholds for individual items, one at a time (Millsap, 2011). All model comparisons were made using the DIFFTEST option in M*plus*, such that statistically nonsignificant DIFFTEST results (i.e., $p > .05$) indicated measurement invariance across gender (see Asparouhov & Muthén, 2006).

CFI and RMSEA were reported for all models. Model fit indices guidelines suggest that CFI values of .90 represent "good" fit to the data, whereas .95 or better represents "excellent" fit (Hu & Bentler, 1999). RMSEA values equal to or less than .05 indicate a closer fit to the data, whereas .08 and .10 suggest fair and marginal fit, respectively (Browne & Cudeck, 1993).

Results. See Table 1 for descriptive statistics. See Supplementary Tables 1 and 2 for item content and correlations among SURPS items, respectively (all supplementary tables are available in online version of the article). The four-factor structure of the SURPS exhibited poor model fit, $\chi^2(224) = 1595.39$, CFI = .84, RMSEA = .09.[3] Likewise, the configural and scalar models of the four-factor structure demonstrated poor model fit, and the assumption of scalar invariance across gender was not met (see Table 2). Configural and scalar models by subscale demonstrated good-to-excellent fit, according to CFI (see Table 2). However, RMSEA values for configural and scalar models suggested inadequate fit. The assumption of scalar invariance by gender was only met for the IMP subscale of the SURPS (see Table 2).

Part 2

Given the poor model fit of the overall four-factor structure and lack of scalar invariance exhibited for AS, H, and SS, item-level analyses were conducted using IRT. These analyses served to inform our attempts to refine the SURPS (consistent with current trends in psychometric reevaluations;

Table 2. Measurement Invariance Summary Fit Statistics.

Model	χ^2	df	CFI	RMSEA	DIFFTEST (p)
Overall model					
Configural model	1760.40*	448	.85	.09	
Scalar model	1816.82*	513	.85	.08	181.58 (<.01)
Anxiety sensitivity full					
Configural model	43.43*	10	.97	.10	
Scalar model	81.72*	24	.95	.08	46.23 (<.01)
Hopelessness full					
Configural model	366.19*	28	.94	.18	
Scalar model	398.63*	49	.94	.14	167.55 (<.01)
Impulsivity full					
Configural model	68.56*	10	.97	.13	
Scalar model	50.66*	24	.99	.06	14.42 (.42)
Sensation seeking full					
Configural model	62.02*	18	.97	.08	
Scalar model	132.12*	35	.93	.09	73.06 (<.01)
Overall revised model					
Configural model	650.34*	168	.92	.09	
Scalar model	670.83*	209	.93	.08	87.87 (<.01)
Anxiety sensitivity revised					
Configural model	0.00*	0	1.00	.00	
Scalar model	18.03*	8	.98	.06	18.32 (.02)
Hopelessness revised					
Configural model	136.19*	10	.97	.19	
Scalar model	98.21*	24	.98	.09	33.33 (<.01)
Impulsivity revised					
Configural model	17.52*	4	.99	.10	
Scalar model	20.48*	15	1.00	.03	11.40 (.41)
Sensation seeking revised					
Configural model	0.00*	0	1.00	.00	
Scalar model	17.07*	8	.99	.06	17.52 (.03)

Note. $N = 718$. χ^2 = chi-square test of model fit; df = degrees of freedom; CFI = comparative fit index; RMSEA = root mean square error of approximation; DIFFTEST = chi-square difference testing between the configural and scalar model; DIFFTEST degrees of freedom = degrees of freedom in configural models subtracted from degrees of freedom in scalar models; Full = full subscale with original items; revised = trimmed subscale; anxiety sensitivity revised = Items 10, 18, and 21; hopelessness revised = Items 4, 7, 13, 20, and 23; impulsivity revised = Items 2, 5, 11, and 15; sensation seeking revised = Items 6, 9, and 16. Given the use of weighted least squares means and variances adjusted (WLSMV) estimation, a traditional chi-square difference test is not appropriate and therefore not reported (see Muthén & Muthén, 1998-2017, p. 451). $p < .05$ suggests a failure to demonstrate scalar invariance across gender.
*$p < .01$.

e.g., Reise et al., 2013). These were conducted separately for males and females given scalar invariance was not demonstrated by most subscales in this sample.

Item Response Theory. To obtain item-level information at specified trait levels (θ), IRT was applied to the SURPS. Given the SURPS has an ordered, categorical response format (i.e., 4-point Likert-type scale), the most appropriate IRT model to explore item-level information was the graded response model (GRM), an extension of the two-parameter logistic model (see de Ayala, 2013; Embretson & Reise, 2000; Samejima, 1970, 1996). In this framework, category response curves (CRCs) provide the probability of an individual responding within a given category, conditional on trait level

for each item (see Embretson & Reise, 2000). Given this is an extension of the two-parameter logistic model, two IRT parameters are estimated: a_i (the discrimination parameter) and b_i (the threshold, or difficulty, parameter). The item discrimination parameter estimates the strength of an item's relation (i.e., slope) to the latent construct, or how well the item discriminates between individuals of differing latent trait levels (Embretson & Reise, 2000). Ranges of discrimination values are categorized as follows: 0.01 to 0.24 (*very low*), 0.25 to 0.63 (*low*), 0.65 to 1.45 (*moderate*), 1.35 to 1.69 (*high*), and >1.7 (*very high*; Baker, 2001). The item difficulty parameter estimates the location where an individual has a 50% chance of endorsement. More specifically, given the SURPS has four response options, the GRM estimates

three b parameters, which correspond to the following response option comparisons: $b_1 = 1$ versus 2, 3, or 4; $b_2 = 1$ or 2 versus 3 or 4; and $b_3 = 1, 2,$ or 3 versus 4 (Embretson & Reise, 2000). IRT parameters were estimated for each subscale for males and females using SAS PROC IRT (SAS Institute Inc., Cary, NC, USA), with marginal maximum likelihood estimation and a logit link function. All IRT plots (i.e., CRCs and information curves) were generated using IRT parameter estimates from M*plus* using CFA models with categorical indicators. Because no cutoffs to guide scale reduction in IRT exist, items were retained based on discrimination and item information function (see Supplementary Table 3, Figure 1 and Supplementary Figure 1 to maximize precision and content coverage across the latent trait. In other words, height of item information curves was used to guide item selection, but location and spread were also considered (see Embretson & Reise, 2000).

Assessing Reliability and Validity. All bivariate correlations were computed in M*plus* with TYPE = BASIC, as it provides correlations based on the scale of the variable (e.g., tetrachoric correlation for two binary variables; L. K. Muthén & Muthén, 1998-2017). We assessed convergent and discriminant validity by calculating bivariate correlations among the SURPS subscales, ASI-3 anxiety sensitivity, CES-D depressive affect, HHI hopelessness, and UPPS-P impulsivity-like facets. Concurrent criterion validity was assessed with bivariate correlations among the SURPS subscales and substance use involvement, as assessed by the ADAS. In addition to the traditionally used measure of internal consistency (i.e., Cronbach's alpha), coefficient omegas for categorical items were also computed using R software (R Development Core Team, 2011).

Treatment Assignment Simulation. Finally, to examine SURPS-based treatment assignment, we conducted treatment simulation analyses by classifying participants into hypothetical treatment conditions (i.e., scoring 1 standard deviation over the mean on at least one subscale, assigning individuals to the treatment based on which "showed the most statistical deviance according to z-score"; Conrod et al., 2008, p. 182). Treatment assignment was completed using nonstratified (i.e., the typical method) and gender-stratified z-scores for the SURPS, as well as the 15-item version.

Results. Item discrimination parameters (a_i) ranged from 1.18 to 2.21 for AS across males and females (see Supplementary Table 3), which reflects moderate-to-very high discrimination (Baker, 2001). For males, Items 8 and 14 were identified as the least informative items based on discrimination and item information (see Supplementary Table 3; Figure 1 and Supplementary Figure 1). These items were also the least discriminating items and provided the least

information, for females (in addition to Item 21). Indeed, items with low information corresponded to broad, undifferentiating CRCs (see Item 8), as opposed to more narrow peaks (see Item 18). Considering this information, Items 8 and 14 were removed.

Discrimination parameters ranged from 1.58 to 2.78 for H across males and females (see Supplementary Table 3), which suggests high-to-very high discrimination (Baker, 2001). For males, Items 1 and 17 were the least discriminating items and provided the least amount of information (see Supplementary Table 3; Figure 1 and Supplementary Figure 1). Likewise, for females, Items 1 and 17 were the least discriminating items and, in general, provided the lowest amount of information across the latent trait (see Supplementary Table 3; Figure 1; see also Supplementary Figures 1 and 2 for CRCs). Thus, Items 1 and 17 were removed.

Discrimination parameters for IMP ranged from .96 to 3.42 across males and females, which indicates moderate-to-very high discrimination (Baker, 2001). For both males and females, Item 22 was the least discriminating item and provided the least amount of information based on the item information curves and CRCs (see Supplementary Table 3; Figure 1 and Supplementary Figure 1). Given this, Item 22 was removed. No other items were deemed problematic.

Discrimination parameters for SS ranged from .76 to 2.08 across males and females, which reflects moderate-to-very high discrimination (Baker, 2001). For females, Item 19 exhibited the lowest discrimination and provided the least amount of information. Although this item demonstrated significantly higher discrimination for males, the location and spread of information was on the lower end of the trait (see Supplementary Table 3; Figure 1). Given this, Item 19 was removed. Likewise, Item 12 was poorly discriminating for both males and females, and the difficulty parameters were unevenly distributed for males (see Supplementary Table 3). Therefore, Item 12 was removed. Finally, Item 3 was removed, as the location and spread of information were undesirable (e.g., more peaked on the lower end of the trait). Additionally, difficulty parameters for Item 3 were unevenly distributed for males and suggested a binary distribution for both males and females (see Supplementary Figure 1 for CRCs).

The revised, 15-item SURPS scale demonstrated improved model fit, $\chi^2(84) = 591.09$, CFI = .92, RMSEA = .09), though fit was still suboptimal. Configural and scalar models for the revised four-factor structure also exhibited improved model fit compared with the original four-factor structure; however, the assumption of scalar invariance by gender did not hold for the overall 15-item scale (see Table 2). Compared with the original subscales, configural model fit improved for revised subscales that were not just identified (i.e., H and IMP; see Table 2). The magnitude of the DIFFTESTs decreased for the revised
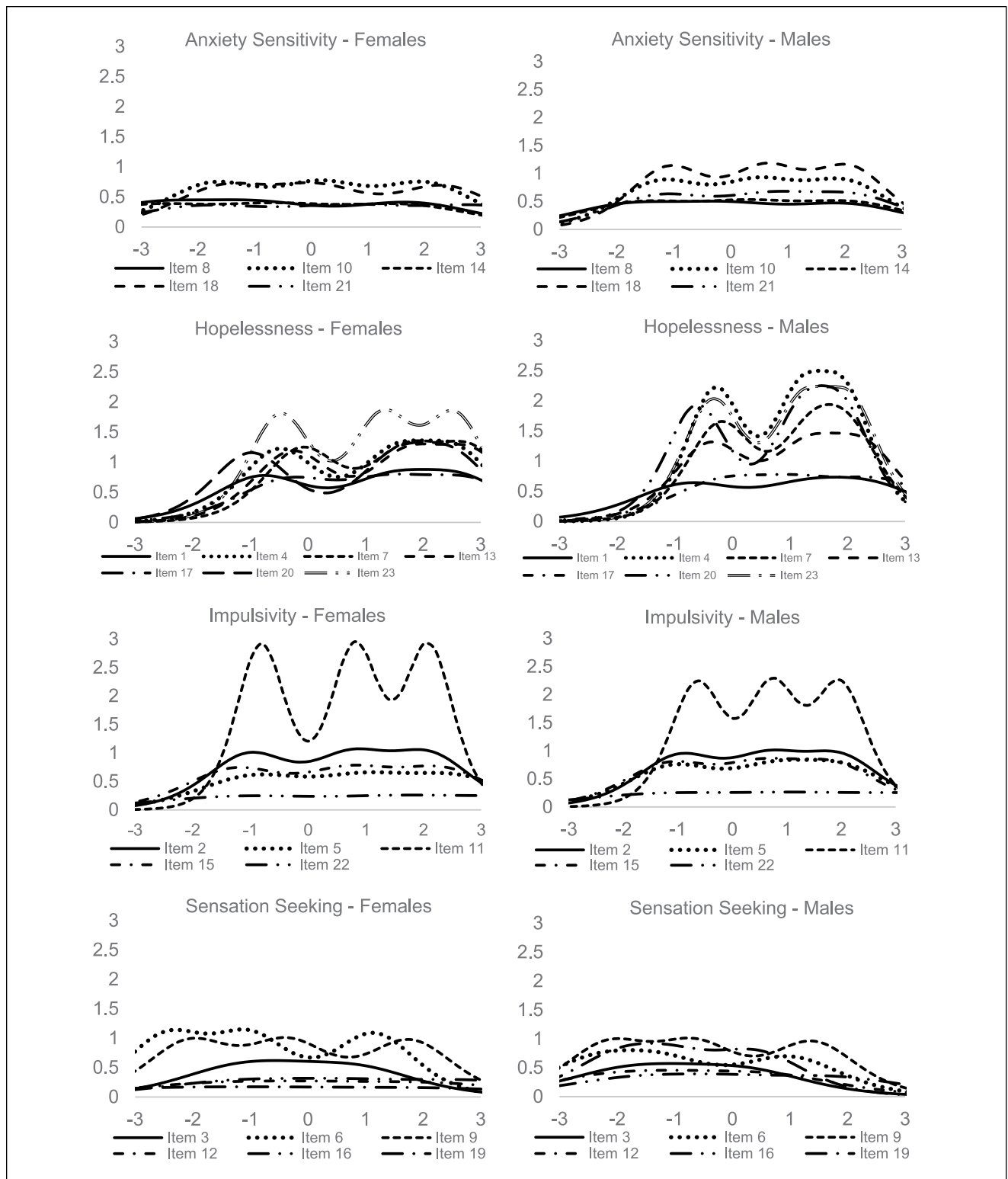
Figure 1. Item information curves for full SURPS items by gender.
Note. SURPS = Substance Use Risk Profile Scale; AS = anxiety sensitivity; H = hopelessness; IMP = impulsivity; SS = sensation seeking; *x*-axis = θ (level of the trait assessed); *y*-axis = information. Item information curves for the full 23-item SURPS items.

subscales compared with the original subscales, which suggests an improvement from the original subscales with respect to gender invariance (see Table 2). However, scalar invariance was not demonstrated for the revised subscales, except for IMP (which was invariant in the original subscale).

Revised subscales that did not achieve scalar invariance were then tested for partial scalar invariance. Some evidence was found for partial scalar invariance for AS and SS when freeing equality constraints for single items (i.e., statistically nonsignificant DIFFTESTs). However, when freeing one item at a time, partial scalar invariance was not demonstrated for the revised H. Only by relaxing equality constraints for three of five items was partial scalar invariance reached. See Supplementary Table 4 for DIFFTEST estimates.

IRT parameters, CRCs, and total information curves were then reestimated by gender for the revised subscales (see Figure 2, Supplementary Figure 2, and Supplementary Table 3). Total information curves represent the total information of SURPS subscales across trait estimates, such that total information is the sum of information across all response options for each item across all trait levels. Examination of test information curves of the 15-item and 23-item SURPS demonstrated the 15-item version, in some cases, provided less overall information due to reduction of eight items (see Figure 2).

For AS across males and females, shape of the curve was not significantly altered, which indicates precision of trait measurement was not significant changed. Total information curves for H across males and females indicated some change in curve shape. Across males and females for H, shapes for the curves were not significantly altered and minimal information was lost. Total information curves for IMP across males and females suggested slight differences. For females, peaks of test information increased slightly, which suggests a slight improvement in measurement precision for individuals whose abilities fall near these peaks (see Figure 2). For males, shape of the curve was not significantly altered and loss of information was minimal. Total information curves for SS across males and females indicated some differences. For males, the revised subscale provided more consistent measurement across the trait, as opposed to more information toward the lower end of the trait (see Figure 2). For females, shape of the curve was not significantly altered and loss of information was minimal.

Internal consistency reliability estimates (as determined by Cronbach's alpha) were in the questionable-to-good range across original subscales. Coefficient omega values were higher across subscales. For revised subscales, Cronbach's alpha estimates decreased given the reduction in items. Coefficient omega values for revised subscales were comparable to Cronbach's alpha estimates (see Table 3 for estimates).

Associations of the SURPS original and revised subscales with ASI-3 anxiety sensitivity, CES-D depressive affect, HHI hopelessness, and UPPS-P impulsivity-like facets are presented in Table 4. Convergent validity was demonstrated for the original subscales. Of the SURPS subscales, AS exhibited the strongest relation with ASI-3. Likewise, H was most strongly associated with CES-D and HHI, and SURPS SS was most strongly associated with UPPS-P SS. IMP demonstrated the strongest associations with positive and negative urgency (see Table 4). Revised subscales also exhibited convergent validity with a comparable pattern of associations (see above the diagonal of Table 4). There is also evidence for discriminant validity given these patterns of associations. Although dissimilar constructs exhibited statistically significant correlations (e.g., HHI H-IMP $r = .18$), magnitudes of the effect sizes often differed (e.g., small vs. medium; see Table 4). Finally, part-whole correlations (i.e., correlations between respective subscales of the 15-item and 23-item SURPS) ranged from .83 to .96 (see Table 4 along the diagonal).

Evidence for criterion validity of the SURPS was mixed across original and revised SURPS subscales (see Table 5). For example, although original and revised AS was not significantly associated to any substance use outcome, the effect size for the association between AS and past-month depressant use increased marginally for the revised subscale (i.e., $r = .09$ vs. $r = .12$). However, the effect size for the association between revised AS and past-month smokeless tobacco use was reduced (see Table 5). Revised H did not significantly improve criterion validity, as effect sizes were reduced across all substance use outcomes. Consistent with the original subscale, revised H was significantly associated with past-month depressant use and alcohol problems; however, all other outcomes were statistically nonsignificant. Revised IMP exhibited increased effect sizes for several substance use outcomes (i.e., past-month stimulant use, cigarette use, smokeless tobacco use, depressant use, and alcohol intoxication), which suggests an improvement compared with the original subscale. Likewise, revised SS also improved predictive ability for some substance use outcomes as evidenced by increased effect sizes (i.e., past-month depressant use, cannabis use, frequency of alcohol intoxication, and alcohol problems; see Table 5). Revised IMP and SS subscales were significantly associated with all substance use outcomes, whereas the original subscales were not. For treatment assignment simulation results, refer to supplementary Table 5. More individuals were assigned to the AS condition and fewer to the SS condition when using the 15-item SURPS compared with the 23-item SURPS (see the Discussion for more).
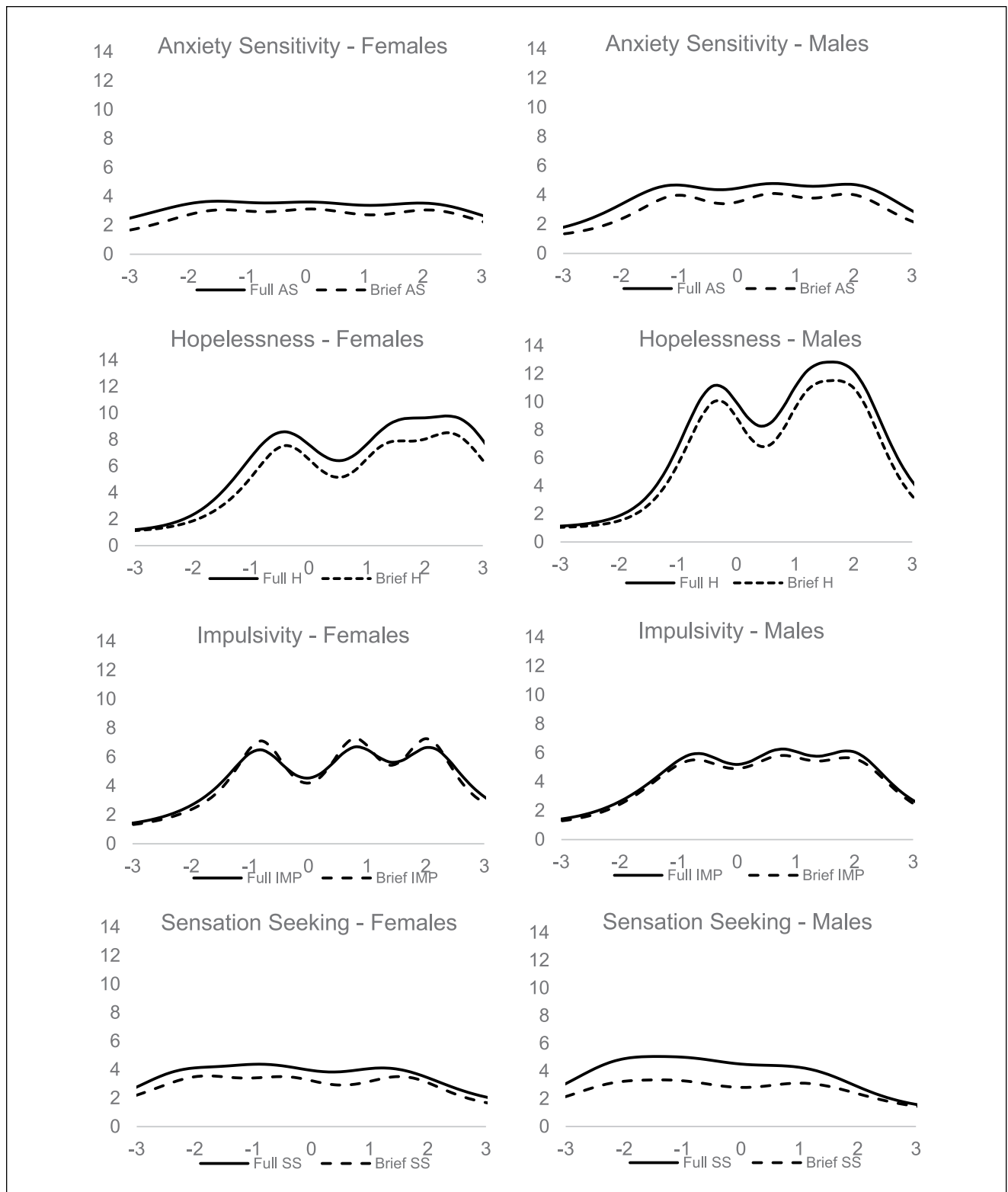
Figure 2. Total item information curves for full and revised SURPS by gender.
Note. SURPS = Substance Use Risk Profile Scale; Full = 23-item SURPS; Brief = 15-item SURPS; AS = anxiety sensitivity; H = hopelessness; IMP = impulsivity; SS = sensation seeking; *x*-axis = θ (level of the trait assessed); *y*-axis = information.

Table 3. Internal Consistency of the Substance Use Risk Profile Scale (SURPS).

Subscale	Full α	Revised α	Full ω	ω 95% CI	Revised ω	ω 95% CI
Anxiety sensitivity	.71	.64	.72	[.68, .78]	.64	[.58, .69]
Hopelessness	.85	.83	.87	[.84, .88]	.84	[.81, .87]
Impulsivity	.75	.75	.76	[.73, .79]	.76	[.72, .79]
Sensation seeking	.68	.64	.73	[.69, .76]	.63	[.58, .69]

Note. α = alpha; ω = omega; 95% CI = 95% bias-corrected bootstrap confidence intervals for omega.

Table 4. Convergent and Discriminant Validity of the Substance Use Risk Profile Scale (SURPS).

	AS	H	IMP	SS	PU	NU	LPer	LPlan	SenS	HHI	ASI	Dep
AS	.91**	.14**	.27**	.02	.19**	.26**	.21**	.05	−.18**	.15**	.57**	.26**
H	.15**	.96**	.11**	−.15**	.25**	.31**	.42**	.14**	−.14**	.73**	.26**	.47**
IMP	.28**	.21**	.97**	.42**	.52**	.55**	.32**	.46**	.12**	.13**	.26**	.17**
SS	−.06	−.15**	.30**	.83**	.30**	.23**	.06	.28**	.53**	−.08**	.02	.02
PU	.15**	.37**	.57**	.18**								
NU	.27**	.30**	.54**	.10**	.68**							
LPer	.20**	.44**	.33**	−.04	.31**	.33**						
LPlan	.00	.14**	.44**	.18**	.29**	.34**	.48**					
SenS	−.20**	−.13**	.12**	.68**	.23**	.15**	−.21**	.02				
HHI	.10**	.72**	.18**	−.15**	.32**	.33**	.46**	.20**	−.17**			
ASI	.55**	.30**	.30**	−.03	.27**	.32**	.23**	.06	−.15**	.31**		
Dep	.26**	.52**	.21**	−.03	.17**	.35**	.30**	.08*	−.10**	.46**	.35**	

Note. N = 718. AS = SURPS anxiety sensitivity; H = SURPS hopelessness; IMP = SURPS impulsivity; SS = SURPS sensation seeking; PU = UPPS-P positive urgency; NU = UPPS-P negative urgency; LPer = UPPS-P lack of perseverance; LPlan = UPPS-P lack of planning; SenS = UPPS-P sensation seeking; HHI = Herth Hope Index hopelessness; ASI = Anxiety Sensitivity Index-3; Dep = Center for Epidemiologic Studies–Depression Scale. Correlations reported below the diagonal include the 23-item SURPS. Correlations above the diagonal include the 15-item SURPS. Pearson's product-moment correlations are reported. Part-whole correlations between respective 15-item and 23-item SURPS subscales are reported along the diagonal. *p < .05. **p < .01.

Table 5. Criterion Validity of the Substance Use Risk Profile Scale (SURPS).

	AS	H	IMP	SS	PMStim	PMCig	PMDip	PMDep	PMCanna	PMDrunk	AlcProb
AS					.04	−.04	−.03	.12	.03	−.03	.06
H	.15**				.13	.04	−.03	.20*	.06	.06	.12**
IMP	.28**	.21**			.28*	.21*	.23*	.29*	.22*	.29*	.22**
SS	−.06	−.15**	.30**		.34**	.30*	.32*	.20*	.40**	.33*	.19**
PMStim	−.02	.16*	.19*	.23*							
PMCig	−.08	.17*	.16*	.29*	.49**						
PMDip	−.10	−.14	.15	.36**	.40**	.66**					
PMDep	.09	.22*	.16*	.15	.81**	.41**	.34**				
PMCanna	.00	.21*	.22*	.33*	.65**	.53**	.37**	.56**			
PMDrunk	−.04	.22*	.27*	.24*	.57**	.48**	.36**	.40**	.57**		
AlcProb	.03	.15**	.25**	.14**	.32*	.31*	.17*	.31*	.34**	.45**	

Note. N = 718. AS = SURPS anxiety sensitivity; H = SURPS hopelessness; IMP = SURPS impulsivity; SS = SURPS sensation seeking; PMStim = past-month stimulant use; PMCig = past-month cigarette use; PMDip = past-month smokeless tobacco use; PMDep = past-month depressant use; PMCanna = past-month cannabis use; PMDrunk = past-month alcohol intoxication. Correlations reported below the diagonal include the 23-item SURPS. Correlations reported above the diagonal includes the 15-item SURPS. Pearson's product-moment correlations are reported for correlations among two continuous variables (i.e., among the SURPS subscales, SURPS with AlcProb). Spearman correlations are reported for ordinal-continuous correlations (i.e., correlations among SURPS subscales and PMCanna/PMDrunk, AlcProb with PMCanna/PMDrunk). Biserial correlations are reported for binary-continuous relations (i.e., correlations among SURPS subscales and PMStim, PMCig, PMDip, and PMDep; AlcProb with binary variables). Tetrachoric correlations are reported for correlations among two binary variables. Polychoric correlations are reported for ordinal-binary and ordinal-ordinal correlations. *p < .05. **p < .01.

Discussion

The SURPS has been used in a multitude of research and clinical contexts, including personality-targeted treatments. Personality-targeted approaches have some support for efficacy (see Conrod, 2016), including reduced binge drinking (Conrod et al., 2008), reduced consumption and alcohol-related problems (Conrod et al., 2006), and reduced cannabis use (Mahu, Doucet, O'Leary-Barrett, & Conrod, 2015). Importantly, interventions that tailor the treatment approach as a function of personality are inherently dependent on accurate (i.e., psychometrically sound) assessment of personality features. Thus, the purpose of this study was to reexamine the psychometric properties of the SURPS in a large undergraduate sample using a multitude of analyses, including measurement invariance and IRT. Strengths include the use of recommended measurement invariance procedures, use of GRMs from an IRT framework to guide model specification (as opposed to relying on modification indices), and calculation of coefficient omega. Another notable strength of this comprehensive psychometric evaluation is use of the four-factor structure without post hoc modifications. Although analyses provided some evidence supporting the validity of the SURPS (e.g., convergent validity, good internal consistency for H subscale), overall, results failed to find evidence for many psychometric properties assumed when using the 23-item SURPS.

Consistent with previous studies (e.g., Jurk et al., 2015; Omiya et al., 2015; Woicik et al., 2009), the four-factor structure of the SURPS exhibited inadequate model fit. We replicated the good fit found in previous work when correlating residual errors (i.e., Jurk et al., 2015; Woicik et al., 2009) and cross-loading items (i.e., Krank et al., 2011); however, we chose not to proceed with those models for the following reasons. Correlating residual covariances can mask relations in the model, which may include relations to outcomes (e.g., substance use). The SURPS is often used in clinical and research contexts that do not utilize SEM, so these modifications are incongruent with standard use. Additionally, the SURPS is purported to assess distinct constructs, and cross-loading items is indicative of heterogeneity at the item and/or construct level.

The original four-factor SURPS and its subscales, with the exception of IMP, also failed to demonstrate measurement invariance across gender. Although previous studies have suggested invariance (i.e., Memetovic et al., 2014), we posit this discrepancy may be due to different methodologies used to establish measurement invariance (i.e., use of DIFFTEST vs. ΔCFI and ΔRMSEA). Nevertheless, our findings suggest the assumption of measurement invariance across gender, at least in college samples, cannot be made. This is potentially problematic, as much work suggests gender differences may exist across specific personality traits, including neuroticism (i.e., females self-report higher levels; Costa, Terracciano, & McCrae, 2001), SS and IMP (i.e., males self-report higher levels of both; Cross, Copping, & Campbell, 2011), and higher genetic predispositions toward AS among females (Jang, Stein, Taylor, & Livesley, 1999). Given the SURPS did not exhibit measurement invariance across gender (i.e., the SURPS differentially measures constructs across women and men), we believe the common practice of lumping women and men when assigning individuals to treatment using the SURPS is problematic.

Because this could lead to incorrect treatment assignments, we examined this potential by classifying participants in the current study into hypothetical treatment conditions (i.e., scoring 1 standard deviation over the mean on at least one subscale, assigning individuals to the treatment based on which "showed the most statistical deviance according to *z*-score"; Conrod et al., 2008, p. 182). When applying gender-specific standardization (i.e., *z*-scores calculated for males and females separately), 22 more females were eligible for treatment (i.e., 3% of the total sample, though 11 fewer males). When using the full SURPS and the full sample mean for standardizing scores, 34 females (21% of females assigned to treatment) and 49 males (42% of males assigned to treatment) would have been assigned to the SS treatment, compared with 60 females (32% of treatment-receiving females) and 30 males (29% of treatment-receiving males) when using gender-specific standardization procedures. Thus, stratification by gender may be important for informing treatment decisions.

As the first study to apply IRT to the SURPS, our findings evinced significant item-level concerns. Broadly, across males and females, each subscale contained items that provided little information across trait levels. Furthermore, items which provided more information did so with inconsistent precision across trait levels of interest (i.e., positive *z*-scores, such as Item 11 for IMP). Other item-level issues included poorly discriminating items (e.g., Items 8 and 22) and binomially distributed items (i.e., Item 3 from SS, "I would like to skydive"). It is our belief that using an IRT framework allowed for a more sensitive examination of the SURPS and supported empirically guided modifications to the scale. We also removed two of the three items which were cross-loaded in previous studies to achieve better fit (i.e., Items 17 and 22; Jurk et al., 2015), indicating some consistency regarding poor item functioning across studies.

The revised 15-item scale demonstrated minor improvements in psychometric properties, though remained substandard. For example, the four-factor structure exhibited improved model fit (though not good fit), partial scalar measurement invariance (indicating some items function differently for men and women across three out of the four subscales), and improved predictive ability for SS and IMP for most substance use outcomes despite reduced items.

However, evidence for predictive utility was not improved for AS and was diminished for H with the reduction in items. Items removed for H were done so because they were, comparatively, the least related to the latent trait being assessed by the SURPS. However, it appears removed items (e.g., Item 17, "I feel that I'm a failure") are accounting for some variance in substance involvement. Speculatively, it may be removed items assess neuroticism more broadly, which has demonstrated relations with substance use (see Littlefield & Sher, 2016).

Despite a modicum of evidence for improved psychometric properties, the 15-item scale has considerable limitations. Although evidence suggesting partial scalar invariance for revised subscales was demonstrated, it is important to note 33% to 60% of items and corresponding thresholds had to be freed (i.e., males and females allowed to differ) to obtain this. Indeed, partial scalar invariance remains inadequate, as this implies a minimum of one item functions differently across males and females per subscale—which has important implications. To retain at least three items per subscale (J. Wang & Wang, 2012), subpar items were retained despite little information being contributed (e.g., Item 16 on SS). Likewise, compared with items of other subscales, information functions of AS items were low, so improvements to the revised version were limited without the addition of new items. Using the 15-item SURPS to assign participants into hypothetical treatment conditions, 43 more participants (i.e., 6% of the total sample) were eligible for treatment when using gender-combined standardization, and 8 more participants (i.e., 1% of the total sample) were eligible when using gender-specific standardization. In sum, when the 15-item, partial scalar gender invariant version of the SURPS was used, more individuals were eligible for treatment. These results again highlight the need to stratify by gender when using the SURPS, in addition to the need for measurement invariance testing across groups of interest for the SURPS and other measures used in psychological research and clinical practice.

Despite this evidence (or lack thereof), should researchers choose to proceed with using the SURPS, it may be beneficial to use the 15-item SURPS modeled in the present study (pending replications from independent samples and more rigorous predictive validity analyses), as this approach achieved better model fit without compromising the structure of the SURPS. However, we only recommend use of this 15-item version with existing SURPS data as a way to ameliorate some (though not all) psychometric issues with the 23-item SURPS. Plainly stated, despite using the "best" items in terms of psychometric information from each subscale, these items failed to yield a measure with adequate psychometric properties. The 23-item SURPS contains items that may produce inaccurate trait scores due to poor discrimination and low information. Additional items should be considered for inclusion into the SURPS.

Regardless, use of the 23-item SURPS is not recommended and presents serious implications for clinical interventions and prevention efforts. Furthermore, clinical and nonclinical norms should be established given the SURPS' widespread use in a multitude of settings, including high-risk samples (e.g., Kazemi et al., 2015), potentially impacting treatment selection.

Considering current findings, of notable concern is the use of the SURPS to determine personality-specific treatment selection—its intended purpose. In a number of studies, if individuals scored above 1 standard deviation from the mean (often a school-specific, rather than normative, estimate) on a specific subscale, they were placed in the treatment targeting that personality trait; furthermore, if more than one subscale score was above 1 standard deviation, the individual was assigned to treatment based on the subscale with the highest z-score (e.g., Castellanos & Conrod, 2006; Conrod et al., 2006; Conrod et al., 2008; Mushquash et al., 2007), even if subscale score differences were nonsignificant. As we demonstrated in this study, items/subscales of the SURPS do not adequately assess the latent traits purported to be measured, so it may be individuals were erroneously assigned to treatment. For example, if items are skewed toward participants with positive z-scores, individuals could be inaccurately placed (or not placed in treatment at all) due to measurement error. This issue could produce "treatment orphans/imposters," such that individuals elevated in a latent trait are not assigned to treatment (i.e., treatment orphans) or assigned to treatment that is suboptimal (i.e., treatment imposters; see Martin, Langenbucher, Kaczynski, & Chung, 1996, for more on imposters).

Given the lack of measurement precision and information provided by AS items, in our simulation, 54 individuals were assigned to the AS treatment using the 23-item SURPS, compared with 95 using the 15-item SURPS (indicating 41 hypothetical treatment orphans). Furthermore, there were multiple instances in which participants' z-scores were above 1 standard deviation across two or three subscales, (i.e., 36% of the of treatment-eligible participants using the 23-item SURPS and 37% using the 15-item SURPS); moreover, there were several instances in which individuals were assigned to one treatment over another based on less than one hundredth of a difference in z-scores. More broadly, and perhaps more important, this also assumes the higher latent trait score on a given personality construct is the personality trait contributing to problematic substance-related behaviors. Even if this assumption is correct, current findings indicated IMP was most strongly correlated with the urgency subscales of the UPPS-P. This suggests IMP-targeted treatments may be more effective (speculatively), if emotion regulation strategies were taught, rather than targeting "aggressive thinking and not thinking things through" (Conrod et al., 2008, p. 184). These issues

are concerning considering the promise of personality-targeted interventions in the literature (see Conrod, 2016).

Beyond the psychometric properties of the SURPS, assignment to personality-targeted interventions assumes equal effectiveness across intervention types. Hypothetically, say an individual is 1.2 standard deviations above the mean on one scale (e.g., IMP) and 1.1 above on another (e.g., SS). Even assuming perfect assessment of these constructs, there is a lack of evidence indicating it is better to assign this individual to a given treatment based on their highest subscale score. For example, it may be the treatment tailored to SS is relatively more effective than the treatment tailored to IMP. Thus, though personality-targeted interventions are consistent with the movement toward "precision medicine" (Insel, 2014), differential assignment as a function of subscale score represents only a first step in this type of patient-treatment matching.

Despite noteworthy strengths of the current research (e.g., IRT), findings should be interpreted in light of study limitations. Although obtained at a Hispanic-serving institution, the sample was composed of students who primarily identified as White and female, which may limit the generalizability of our findings. Furthermore, the SURPS was created, and often validated, with adolescent samples, so it is difficult to contextualize our findings within this literature. Because this was part of a larger data collection examining personality and substance use, more broadly, some of the measures used for establishing convergent and criterion validity (e.g., the CES-D, ADAS) were suboptimal (e.g., single-item indicators of substance use). Again, we want to point out that the solution generated by the current study (i.e., removal of eight items), also exhibited substandard psychometric properties, including retention of poorly discriminating, low information items to maintain at least three items per scale. Thus, we were unable to provide an acceptable alternative to the SURPS based on the items included in this scale. Despite these limitations, we believe the current work contributes valuable information regarding the psychometric validity of the SURPS.

Our primary recommendation is to prioritize the use of assessments with evidence supporting psychometric validity in the literature. However, given the focus of our study was an evaluation of the SURPS, we refrain from providing specific assessment recommendations. Indeed, although other work suggests the construct of anxiety sensitivity is a correlate of alcohol-related outcomes in some populations when using alternative measures (e.g., Stewart, Zvolensky, & Eifert, 2001), the lack of evidence for criterion validity for AS in the current study and others (e.g., Malmberg et al., 2010; Moser et al., 2014; seminal work regarding the psychometric properties of the SURPS; Woicik et al., 2009), raises the broader question: What is the utility of simultaneously assessing these constructs, as indexed by the SURPS, to predict substance-related outcomes?

Specifically, although the SURPS was intended to assess personality constructs associated with motivations for alcohol, its construction was largely atheoretical and founded on little psychometric work. Furthermore, it remains unclear whether these traits are optimal for assessing substance use risk. For example, although an association between H and substance-related outcomes is sometimes found, this may be due to more specific relations (e.g., a facet of hopelessness), or a larger trait (e.g., Neuroticism) of which hopelessness is a facet. Therefore, we also refrain from providing a recommendation for a measure of hopelessness, given this issue, as well as the insufficient psychometric support for existing measures (e.g., Beck Hopelessness Scale; Beck, Weissman, Lester, & Trexler, 1974). In sum, in addition to the psychometric issues of the SURPS, fundamental issues of construct predictive utility remain.

Current findings provided insufficient support for internal consistency (as assessed by Cronbach's alpha and coefficient omega) and measurement invariance across gender, among other psychometric necessities, for both, the 23-item and the revised 15-item SURPS. Should researchers and clinicians continue to use the SURPS, despite lack of adequate psychometric support, future directions include adding items with better discrimination and information, establishing clinical and nonclinical norms, and examining whether assessing the four personality traits provides incremental predictive validity. Given evidence that specific subscales did not predict substance use outcomes (i.e., AS), the utility of assessing these four traits simultaneously needs to be examined. Research future directions include determining which individual differences (e.g., personality, motives) serve as the best predictors of risk for alcohol and substance misuse and constructing a brief, self-report measure that can be used to assess these differences in research and clinical settings. Given that 36% to 37% of our sample endorsed two or more elevated scales in our simulation analyses, combined with significant subscale interactions, examining how within-person interactions influence substance use outcomes utilizing a multilevel framework is an important area for future research. We also suggest the application of rigorous psychometric work to any instrument which will be used to determine individual prevention and treatment plans.

In the spirit of conducting comprehensive, rigorous psychometric reevaluations on popular, widely used personality assessments (see Reise et al., 2013; Steinberg et al., 2013), the current study reexamined the psychometric properties of the SURPS in a college sample. We utilized multiple statistical approaches, including testing measurement invariance across gender using suggested multigroup procedures in SEM and item-level analyses using an IRT framework. Although our analyses yielded a brief, 15-item version of the SURPS which has more evidence in support of its psychometric validity compared with the 23-item version, we caution against use of these items to represent such

complex personality traits. Indeed, as psychometric methods advance, it is likely many widely used scales may be deemed psychometrically inadequate (e.g., the Barratt Impulsiveness Scale–Version 11 [BIS-11]; Reise et al., 2013). More work is necessary, but these findings do not provide adequate evidence supporting the psychometric validity of the SURPS in college samples.

Declaration of Conflicting Interests

Funding

Notes

1. The following frequencies were collapsed for past-month frequency of alcohol intoxication: 4.18% endorsed "10-19 times" and 3.49% endorsed "20 or more times." Collapsed frequencies for past-month cannabis use included the following: 3.48% endorsed "10-19 times," 3.20% endorsed "20 or more times," and 2.51% endorsed "several times a day."
2. Copyright © [2002-2014] SAS Institute Inc. SAS and all other SAS Institute Inc. product or service names are registered trademarks or trademarks of SAS Institute Inc., Cary, NC, USA.
3. We also tested two respecified models, which exhibited improved fit in previous studies. When removing Items 16, 19, and 22, and correlating residuals for Items 1 and 4, Items 4 and 20, and Items 7 and 23, model fit improved (CFI = .91, RMSEA = .08; see Krank et al., 2011). Next, when cross-loading Item 16 on IMP and SS, cross-loading Item 17 on H and AS, cross-loading Item 22 on IMP and AS, and correlating residuals for Items 7 and 13, Items 13 and 17, Items 1 and 4, Items 4 and 20, and Items 7 and 23, model fit also improved (CFI = .91, RMSEA = .07; see Jurk et al., 2015).

Supplemental Material

Supplemental material for this article is available online.

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