Sensitivity and Specificity of a Brief Personality Screening Instrument in Predicting Future Substance Use, Emotional, and Behavioral Problems: 18-Month Predictive Validity of the Substance Use Risk Profile Scale

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Background: This study assessed the validity, sensitivity, and specificity of the Substance Use Risk Profile Scale (SURPS), a measure of personality risk factors for substance use and other behavioral problems in adolescence.

Methods: The concurrent and predictive validity of the SURPS was tested in a sample of 1,162 adolescents (mean age: 13.7 years) using linear and logistic regressions, while its sensitivity and specificity were examined using the receiver operating characteristics curve analyses.

Results: Concurrent and predictive validity tests showed that all 4 brief scales—hopelessness (H), anxiety sensitivity (AS), impulsivity (IMP), and sensation seeking (SS)—were related, in theoretically expected ways, to measures of substance use and other behavioral and emotional problems. Results also showed that when using the 4 SURPS subscales to identify adolescents "at risk," one can identify a high number of those who developed problems (high sensitivity scores ranging from 72 to 91%). And, as predicted, because each scale is related to specific substance and mental health problems, good specificity was obtained when using the individual personality subscales (e.g., most adolescents identified at high risk by the IMP scale developed conduct or drug use problems within the next 18 months [a high specificity score of 70 to 80%]).

Conclusions: The SURPS is a valuable tool for identifying adolescents at high risk for substance misuse and other emotional and behavioral problems. Implications of findings for the use of this measure in future research and prevention interventions are discussed.

Key Words: Personality, Substance Use, Adolescence, Emotional Problems, Conduct Problems.

A LCOHOL AND DRUG use are highly prevalent and problematic among youth worldwide (Office of National Statistics, 2008; U.S. Department of Health and Human Services, 2007), with an estimated 9% of all deaths of people aged 15 to 29 years attributed to alcohol misuse alone (World Health Organization, 2011). With the limited success of universal prevention programs in reducing adolescent substance use and misuse (Faggiano et al., 2008; Sloboda et al., 2009), there is a growing interest in selective prevention strategies that target adolescents at risk for substance-related problems.

One area showing promise with respect to understanding and identifying those vulnerable to substance use problems focuses on personality. Among the personality traits commonly cited in the literature as being associated with alcohol and drug use are impulsivity, sensation seeking, hopelessness, and anxiety sensitivity. A number of motivational models of substance misuse vulnerability propose that these 4 personality factors could explain specific patterns of substance use and related comorbidity (for reviews, see Castellanos-Ryan and Conrod, 2012; Pihl and Peterson, 1995). Impulsivity is associated with a deficit in reflectiveness, rapid decision making and action, and a failure to inhibit a behavior (Baumeister and Vohs, 2004). Sensation seeking is generally defined by a low tolerance to boredom, a strong need for stimulation, and a willingness to take risks for the sake of having novel and varied experiences (Arnett, 1994; Zuckerman, 1979). Impulsivity has consistently been associated with a variety of substance use outcomes across the life span (Chassin et al., 2004; Elkins et al., 2006), as well as conduct and externalizing problems in general (Krueger et al., 2002; Tremblay et al., 1994), and has been shown to account for a proportion of the comorbidity between substance use problems and conduct disorder (Khan et al., 2005). Studies have also shown that sensation seeking is an important correlate of drinking

and drug use (Earleywine and Finn, 1991; Magid et al., 2007), as well as early onset alcoholism (Dom et al., 2006) but might be associated with other antisocial behaviors indirectly through substance-related behaviors (Mackie et al., 2011). Hopelessness has been associated with higher rates of alcohol abuse and dependence, sedative drug use, and self-report reasons for substance use linked to depression coping and numbing of painful memories in adults (Woicik et al., 2009), as well as substance use in adolescents (Bolland et al., 2007). Anxiety sensitivity, which is described as a fear of anxiety-related physical sensations because of an unrealistic expectation that they could lead to loss of physical or mental control or other "catastrophic" consequences (Reiss et al., 1986), has also been associated with coping or negative reinforcement motives for substance use (Stewart and Kushner, 2001), high levels of drinking problems (Conrod et al., 1998), smoking and other drug use (Conrod et al., 2000a; Zvolensky et al., 2009), as well as anxiety and panic symptoms in adults (Stewart et al., 2001). However, anxiety sensitivity has been associated with lower levels of substance use in young adolescence (Krank et al., 2011), suggesting a specific developmental course of risk for anxiety-related drinking.

Within this theoretical context, the Substance Use Risk Profile Scale (SURPS) was developed to assess variability on these 4 personality traits and was created using factor analysis on a battery of personality and symptom inventories that tap these 4 personality dimensions (for further detail, see Woicik et al., 2009). The 23-item SURPS is the only brief personality assessment tool that provides relatively independent measurement of these 4 personality traits and is suitable for self-administration by adolescents and adults (Woicik et al., 2009). The brevity of the scale and the ease of completion are extremely advantageous in research contexts where large numbers of participants (often in school settings) are screened simultaneously or complete the scale as part of a larger assessment battery. The SURPS has shown good internal consistency, test–retest reliability, as well as concurrent and predictive validity with respect to identifying future substance misuse in a sample of young binge-drinking adults (Woicik et al., 2009). Importantly, the SURPS has also been shown to have incremental validity over the NEO-FFI scales in predicting drinking problems (Woicik et al., 2009), reflecting the strong relationship between these more specific traits and substance use. Although the psychometrics and validity of the SURPS in predicting substance use have been previously established in adolescents and young adults (Krank et al., 2011; Woicik et al., 2009), no study has shown the associative and predictive value of this measure with regard to nonsubstance use, emotional, and behavioral outcomes, hypothesized to be associated with the personality traits assessed by the SURPS. Thus, the main aim of the current study is to evaluate the sensitivity and specificity of the SURPS scales in the prediction of substance use and other emotional and behavioral problems in a young adolescent sample (mean age: 13.7 at baseline). Because substance use

has its onset in young to mid-adolescence (12 to 14 years; Faden, 2006), results from the current study provide evidence as to the association between personality traits and the onset of different substance use behaviors. As with most instruments that yield continuous scores, the SURPS has proven useful in the research context. However, in the clinical context where early identification of those likely to develop addiction and/or psychological illness in later life is of central importance in implementing prevention programs, what remains lacking are evidence-based cutoffs for identifying those at risk.

Receiver operating characteristics (ROC) curve analyses are used to study the ability of different tests and measures to discriminate between those at risk and not for a disease. The sensitivity of a measure is calculated based on how well the measure identifies those with a disease (in this case substance use and other emotional and behavior problems within an 18-month period). The specificity of a measure is calculated based on "false-positive rates," which refers to how often it mistakenly identifies someone as at risk (i.e., the lower the false-positive rates the higher the specificity). Usually, as the sensitivity of an instrument increases, its specificity decreases. For example, biologic screening tests like the PAP test has been shown to have high specificity (between 86 and 100%) in the screening for cervical cytologic abnormalities, but variable sensitivity (between 30 and 87; Nanda et al., 2000). With respect to substance abuse screening instruments, the Simple Screening Instrument for Substance Abuse (SSI–SA) has been shown to have high sensitivity (87 to 97%; Winters, 1995), but moderate specificity (e.g., 55.2%; Winters, 1995). The Alcohol Use Disorders Identification Test (AUDIT), which was specifically designed to identify problem drinkers in primary care settings (Saunders et al., 1993), has demonstrated sensitivity ranging from 38 to 94% and specificity ranging from 66 to 90% in adult and adolescent samples when age-appropriate cutoffs are used (Chung et al., 2000).

Unlike these other substance abuse screening tools, the SURPS relies on self-report personality and does not ask about substance use, and as such has been shown to be predictive of future substance-related behaviors over and above current substance use behaviors and before the onset of such behaviors (Krank et al., 2011). This gives the SURPS the unique feature of being able to identify adolescents at risk for substance use and alcohol problems prior to the onset of any substance use behavior, which has obvious applications for prevention. Considering previous findings from the studies reviewed above and those from Conrod and colleagues (Castellanos and Conrod, 2006; Conrod et al., 2000b, 2008, 2010), Woicik and colleagues (2009), and Krank and colleagues (2011), we hypothesized that (i) the 4 subscales of the SURPS will positively identify a large portion of the adolescents who go on to use substances and develop problems with substances in mid- and late adolescence; (ii) with respect to specificity of the instrument, considering the specific relationships between each personality construct and certain emotional and behavioral outcomes, high levels of specificity

of each scale will only be achieved in relation to theoretically related outcomes; for example, (iii) hopelessness will be associated with drinking and drinking problems as well as depression symptoms; (iv) anxiety sensitivity will not be associated with increased substance use at this age, but will be associated with emotional problems; (v) impulsivity will be associated with most alcohol use and drug use measures, as well as other externalizing behaviors; and (vi) sensation seeking will be related to drinking and drug use outcomes, but not other emotional and behavioral problems.

MATERIALS AND METHODS

Participants and Procedure

This study analyzes the data from students in the control condition of the adventure trial (O'Leary-Barrett et al., 2010) only, to avoid any contamination effect of the interventions. All students attending year 9 at these schools were invited to participate. As ethical requirements for this study allowed for participation to be informed by passive parental consent and active assent from students, 95% of the entire year 9 population within these schools were recruited. Students were surveyed, at baseline and follow-up, in classroom or assembly formats during school hours using self-report questionnaires. The current sample is made up of a total of 1,162 adolescents (mean age: 13.7 years) from 8 schools in central London, UK, who completed self-report questionnaires in year 9 of high school (time 1) and then again at 6-, 12-, and 18-month (time 4) follow-up. Although participants were not asked to provide information on their socioeconomic status, information available for each of the boroughs where participants attended school indicated that the average net household income in these boroughs (£609 per week) was slightly lower than the London-wide average (£624 per week; Neighborhood Statistics, 2012). The 1,162 adolescents were included in baseline (concurrent) analyses. However, 105 participants provided unreliable data at 1 or more follow-up sessions (i.e., answered positively to a sham drug item, included in the questionnaire to identify overreporting) and so were excluded from any longitudinal analyses (prospective validity and sensitivity and specificity sections). Thus, for the longitudinal analyses included in this study, the sample was comprised of 1,057 adolescents (445 girls), aged 13 to 14 ($M = 13.66$, SD = 0.32), from a variety of ethnic backgrounds (43% White British or other, 27% South-Asian, 17% Black British or other, 7% mixed race, and 6% other).

Attrition

The follow-up rates were 78% ($n = 897$) at 6 months, 89% at 12 months, and 80% at 18 months postbaseline. The majority of participants (61%) were followed up at all time points, with 26% followed up twice, 9% followed up once, and only 3% not followed up at all. Attrition was not predicted by baseline drinking ($p = 0.50$), binge drinking ($p = 0.21$), drug use ($p = 0.08$), or ethnicity ($p = 0.38$), or any other emotional and behavioral outcome (all $p > 0.13$), but was predicted by gender (OR = 0.59; 95% CI, 0.39 to 0.88), showing that males were less likely to be followed. Given these results, we relied on full information maximum likelihood estimation in SPSS (SPSS Inc., Chicago, IL) under the assumption of data MAR that enabled the use of all available data.

Measures

Demographics. Adolescents provided gender and ethnicity information using a multiple-choice procedure.

Personality traits. Personality traits were assessed with the SURPS (Woicik et al., 2009), a 23-item questionnaire which assesses 4 personality risk factors for substance abuse/dependence including hopelessness (H), anxiety sensitivity (AS), impulsivity (IMP), and sensation seeking (SS; see Table 2 for descriptives). Several studies have shown that the SURPS possesses good psychometric properties—internal reliability, convergent, and discriminant validity, as well as 2-month test–retest reliability—when used in adult and adolescent samples (Krank et al., 2011; Woicik et al., 2009). However, because 1 of the SS items ("I am interested in experience for its own sake, even if it is illegal") has been shown to cross-load onto the impulsivity factor in a factor analyses of the SURPS carried out in this sample and a young adolescent Canadian sample (Krank et al., 2011), a revised SS score was used for the analyses in this study, which did not include this item. For item content and modifications to items for this younger British cohort, as well as psychometric information on the SURPS (and all outcome measures) in this sample, see Data S1.

Drinking Outcomes. Alcohol use was assessed using 2 continuous variables (age of drinking onset, frequency of drinking) and three categorical variables (drinking status [only at baseline], binge-drinking status, and drinking problems). Age of drinking onset was assessed by asking participants to report at what age they had their first alcoholic drink. Drinking status was assessed at baseline by asking students whether they had consumed any alcoholic beverage in the past 6 months. At 18-month follow-up drinking frequency was assessed by asking how often adolescents drank alcohol in the past 6 months (6-point scale, never to daily). Binge drinking was assessed by asking students whether they had consumed 5 or more alcoholic beverages (4 or more for girls) on 1 occasion in the past 6 months. An alcohol problems score was created using a shortened version of the Rutgers Alcohol Problem Index (Conrod et al., 2008; White and Labouvie, 1989), which was then dichotomized to assess whether adolescents had experienced any drinking-related problems in the last 6 months. For sensitivity and specificity analyses, 2 dichotomous variables were created to identify those who reported more than 1 drinking-related problem by time 4 and those who reported a period of "monthly binge drinking" by time 4.

Smoking Rates. Smoking was assessed by asking participants whether they smoked cigarettes or not, and if so, how many cigarettes they smoked per week in the last 6 months according to a 5-point scale: (i) not more than 1; (ii) 1 to 5; (iii) 6 to 10; (iv) 10 to 20; and (v) more than 20. For sensitivity and specificity analyses, a variable was created, which identified who had reported smoking at any time point by time 4 (18-month follow-up).

Drug Use. Drug use was assessed using the Reckless Behavior Questionnaire (Shaw et al., 1992), a 10-item measure that asks participants to report how often they have engaged in various risky behaviors over the past 6 months, including marijuana, cocaine, and any other drug use. These 3 drug-related items were then combined to create a drug use frequency score and dichotomized into "yes/no" variables for each drug separately, as well as a combined "any drug use" variable. For sensitivity and specificity analyses, a dichotomous variable was used to represent any drug use more than once in the last 6 months by time 4.

Depression Symptoms. Depression symptoms were measured using the depression (7-item) subscale from the Brief Symptom Inventory (BSI), a standardized self-report symptom inventory designed to serve as a screen for depression (Derogatis, 1993). Research indicates that the BSI depression scale is comparable to the *B*eck *D*epression Inventory and the Brief Psychiatric Rating Scale with respect to its accuracy in detecting depression symptoms in adolescents (Sahin et al., 2002). The total BSI depression subscale

was used for analyses on concurrent and predictive validity. For sensitivity and specificity analyses, participants whose T-score was above 63 were categorized as being in the "abnormal" range following guidelines provided by Derogatis (1993).

Emotional and Behavioral Symptoms. Emotional, conduct, and hyperactivity problems, as well as pro-sociality were assessed using the Strengths and Difficulties Questionnaire (SDQ; Goodman et al., 1998). The SDQ is an internationally validated measure for adolescents aged 11 to 16 (Goodman et al., 1998) and contains five 5-item subscales: emotional, conduct, hyperactivity, peer problems, and pro-sociality. Some SDQ items overlapped with the SURPS ("I am often unhappy, down-hearted, or tearful" and "I think before I do things") and were thus omitted when calculating SDQ subscale scores, which were used in analyses on concurrent and predictive validity. For sensitivity and specificity analyses, those who scored on a particularly high or "abnormal" range on any of the SDQ subscales (scoring ≥ 5 on conduct problems and ≥ 7 on emotional or hyperactivity problems) were identified using bands provided by Goodman and colleagues (1998).

Data Analysis

First, linear and logistic regressions were used to examine whether the SURPS subscales were associated with concurrent as well as future measures of substance use and emotional and behavioral problems. Besides controlling for the effects of the other personality traits (all personality traits are entered into each model at the same time), all analyses controlled for the effects of age, gender, and ethnicity (dichotomized, White British vs. Other), as they have previously been shown to be significantly associated with substance use, as well as other emotional and behavioral problems, in adolescence (Best, 2001; Heyerdahl et al., 2002). In addition, predictive analyses controlled for the effects of baseline outcome measures, for example, when predicting binge drinking 18 months postbaseline, baseline binge drinking was included as a covariate. In this way, outcomes at 18-month follow-up represent change in this outcome across 18-months. For linear and logistic regressions, R^2 are provided as a measure of multivariate effect size, where an R^2 of 0.02, 0.13, and 0.26 are considered a small, moderate, and large effect size (Cohen, 1992). For logistic regressions, odds ratios provide an indication of how large an effect is, with values ranging from 1.00 to 1.50, indicating a small effect and 3.0 or above representing a large effect (Haddock et al., 1998).

Finally, ROC curve analyses were used to investigate the effectiveness of the SURPS subscales as a targeting risk factor, by evaluating the sensitivity and specificity of the scales. The area under the ROC curve (AROC) is a measure of the predictive validity or "accuracy" of the test; the perfect measure has an AROC of 1.00, while a test with no predictive validity has an AROC of 0.50 and a linear ROC curve that parallels the diagonal. Although considered rather arbitrary, AROC values of 0.60 to 0.70, 0.70 to 0.90, and those above 0.90 are generally associated with an acceptable or fair, good, and excellent discriminant test, respectively (Swets, 1988).

The sensitivity of the measures was calculated based on "true-positive rates," that is, on how well the measure identified those who developed substance use and other emotional and behavior problems within an 18-month period. The specificity of the measures was calculated based on "false-positive rates," which refers to how often it mistakenly identified someone as developing a problem within 18 months (i.e., the lower the false-positive rates the higher the specificity). Selecting high-risk adolescents using cutoffs suggested by coordinates on each ROC curve will then be compared with selecting adolescents scoring 1 SD above the population mean on any of the 4 subscales, which is the selection method used in a number of intervention studies (see Conrod et al., 2006, 2008,

2010). Please see Table 1 for descriptives for the SURPS subscales, overall and by gender, and correlations between subscales.

RESULTS

Concurrent and Prospective Validity

See Table 2 for the *concurrent* validity of the SURPS subfactors in the prediction of substance use, as well as emotional and behavioral problems in adolescence. Only *p*-values below 0.01 are reported to address the issue of multiple testing. Table 3 shows prospective associations, with the main findings summarized as follows: (i) once controlling for baseline substance use and emotional symptoms scores, H remained significantly associated with marijuana use rates, drinking problems, tobacco use quantity, drug use frequency, depression, emotional, conduct, and hyperactivity problems; (ii) AS was associated with lower drinking and drug use, but increased emotional problems; (iii) IMP predicted all substance use, hyperactivity, and conduct problems, as well as depression; (iv) SS was prospectively associated with drinking problems, all drug use outcomes except for cocaine use, hyperactivity, and pro-social behavior.

Sensitivity and Specificity

Table 4 shows the area under the curve (AROC) values for each subscale at baseline predicting rates of substance use and other emotional and behavioral problems within the next 18 months, as well as the cutoffs suggested by the coordinates on each ROC curve, that is, cutoff points at which sensitivity and specificity are maximized (see also Figs 1 and 2 for ROC graphs). Overall, results indicate that the SURPS subscales significantly predicted more substance use rates within the next 18 months than predicted by chance, with significant AROC values ranging from 0.59 to 0.74. Cutoff scores suggested by ROC curves for AS and SS are equivalent to scoring 1 SD above the population mean, that is, 13 and 16, respectively (see Table 4 and Fig. 2). However, cutoff scores suggested by ROC curves for IMP are equivalent to scoring closer to the population mean, that is, around 13.8 (see Figs 1 and 2C). The cutoffs for AS, SS, and IMP were similar regardless the outcome, while cutoffs suggested for H varied substantially depending on the outcome studied (ranged from 12.5 for drug use, close to the population mean, to higher than 15 for monthly binge drinking, conduct, and hyperactivity problems, which is similar to scoring 1 SD above the mean).

Table 5 shows sensitivity (*S*) and false-positive rates (FP; which is equal to 1—specificity) when selecting "high-risk" adolescents based on these proposed cutoff points. Using the cutoff points suggested by ROC curves for all 4 scales to select adolescents at high personality risk results in very good sensitivity rates (72 to 91%) but poor specificity, with false-positive rates ranging from 49% (monthly binging) to 72%

Table 1. SURPS Subscale Scores by Gender (*N* = 1,057, 445 Females and 612 Males; Mean Age: 13.7 Years)

	Descriptives			Correlations		
SURPS subscales (score range)	Female mean (SD)	Male mean (SD)	Total mean (SD)	H	AS	IMP
Hopelessness (7–28)	12.98 (3.32)	12.62 (3.65)	12.77 (3.51)			
Anxiety sensitivity (5–20)	11.76 (2.64)	10.84 (2.62)	11.23 (2.67)	0.13*		
Impulsivity (5–20)	12.46 (2.82)	12.28 (2.92)	12.35 (2.88)	0.13*	0.21**	
Sensation seeking-R (5–20)	13.22 (3.06)	14.37 (2.79)	13.88 (2.96)	−0.42***	−0.13*	0.40***

SURPS, Substance Use Risk Profile Scale; R, revised; SD, standard deviation; H, hopelessness; AS, anxiety sensitivity; IMP, impulsivity; Sensation seeking-revised = Items 3, 6, 9, 12, and 19.
Significance level: ***p < 0.001, **p < 0.01, *p < 0.05.

Table 2. Concurrent Prediction of Substance Use, Emotional, and Behavioral Problems by SURPS Subscales at Baseline After Accounting for Effects of Age, Gender, and Ethnicity (*N* = 1,162)

		Model change	SURPS subscale scores (odds ratio/[beta])			
	Rates (%)/[Mean, SD]	Nagelkerke R^2/[R^2]	Hopelessness	Anxiety sensitivity	Impulsivity	Sensation seeking-R
Age of drinking onset	[11.5, 1.10[a]]	[0.06***]	[0.00]	[0.11***]	[−0.21***]	[−0.08**]
Drinking rates	38%	0.05***	1.07	0.69**	2.13***	1.09
Binge-drinking rates	17%	0.07***	1.56	0.97	2.43***	1.22
Any drinking problems	27%	0.09***	1.56***	0.93	2.57***	0.98
Tobacco use rates	9%	0.11***	1.70*	0.57	3.62***	1.14
Marijuana use rates	7%	0.11***	1.80**	0.50**	3.73***	0.88
Cocaine use rates	1%	0.06	1.40	0.86	3.97**	0.86
Other drug use rates	3%	0.12***	2.99**	0.51	4.06***	0.89
Any drug use frequency	[3.19, 0.87]	[0.04***]	[0.09**]	[−0.07]	[0.18***]	[0.01]
BSI depression total	[12.19, 5.22]	[0.22***]	[0.37***]	[0.22***]	[0.09**]	[0.06]
SDQ emotional problems	[3.00, 2.19]	[0.23***]	[0.26***]	[0.38***]	[0.02]	[0.05]
SDQ conduct problems	[2.99, 1.81]	[0.33***]	[0.17***]	[−0.07]	[0.53***]	[0.05]
SDQ hyperactivity problems	[4.47, 2.01]	[0.22***]	[0.19***]	[0.00]	[0.41***]	[0.00]
SDQ pro-social behavior	[6.32, 2.01]	[0.10***]	[−0.24***]	[0.12***]	[−0.18***]	[0.06]

SURPS, Substance Use Risk Profile Scale; SDQ, Strengths and Difficulties Questionnaire; SD, standard deviations; R, revised.
[a]This mean represents the mean age of onset of drinking for those who reported ever having had a drink at baseline (i.e., 50% of the sample); coefficients show unique effects of personality traits, as all 4 personality variables are entered simultaneously into each model; age, gender, and ethnicity were included as covariates: Male gender was associated with later drinking onset (β = 0.15, p < 0.001), lower drinking (OR = 0.56, p < 0.001) and smoking rates (OR = 0.49, p < 0.01), depression (β = −0.15, p < 0.001), emotional problems (β = −0.15, p < 0.001), and pro-sociality (β = −0.18, p < 0.001); White British adolescents had an earlier drinking onset (β = −0.30, p < 0.001), higher drinking rates (OR = 4.09, p < 0.001), drinking problems (OR = 2.46, p < 0.001), and pro-sociality (β = 0.08, p < 0.01); age was not significantly associated with any variable.
Significance level: ***p < 0.001, **p < 0.01, *p < 0.05.

(emotional problems). This could be partly explained by the fact that using cutoff scores that are close to the population mean on some of these scales results in selecting up to 78% of the sample (compared with around 50 to 60% if selecting adolescents that score 1 SD above the population mean). Selecting adolescents that score 1 SD above the population mean on any of these subscales results in slightly reduced, but good sensitivity rates (70 to 80%) and moderate specificity (45 to 58%). These specificities when using the 4 subscales to select adolescents are to be expected as not all subscales are significant predictors of all problem outcomes. Thus, selecting adolescents on the strongest predicting subscale for each indicator (e.g., IMP predicting conduct problems; Fig. 2C) resulted in improved specificity, for example, 70% specificity for future drug use and 80% specificity for conduct problems when identifying adolescents as high risk according to the IMP scale.

A final set of analyses were conducted to quantify risk incurred by each of these personality traits using the cutoffs suggested by ROC curves (for H, the suggested cutoff of 13 for depression problems was used). Table 6 shows odds ratios (OR) and 95% confidence intervals (CI) for those scoring high on these traits when compared with the rest of the sample, as well as compared with those identified as low risk (LR; i.e., those who score below the suggested cutoffs on all 4 traits). Results show moderate to large ORs for those scoring high in H, IMP, or SS in the prediction of problem substance use 18 months later and very large ORs for all subscales in the prediction of serious, theoretically relevant, emotional and behavioral problems 18 months later.

DISCUSSION

The present study examined the utility of a 4-factor scale of personality in predicting substance use and related problems in a longitudinal sample of young British adolescents. Results replicated previous findings showing that these

Table 3. Prospective Prediction of Substance Use, Emotional, and Behavioral Problems at 18-Month Follow-Up by SURPS Subscales at Baseline After Accounting for Effects of Age, Gender, Ethnicity, and Baseline Scores ($N = 1,057$)

	Rates (%)/[Mean, SD]	Model change Nagelkerke R^2/[R^2]	SURPS subscale scores (odds ratio/[beta])			
			Hopelessness	Anxiety sensitivity	Impulsivity	Sensation seeking-R
Drinking frequency	[2.07, 1.26]	[0.03***]	[−0.01]	[−0.05]	[0.16***]	[0.02]
Binge-drinking rates	34%	0.02***	1.01	0.71	1.96***	1.00
Any drinking problems	41%	0.02**	1.40	1.00	1.44**	1.13
Tobacco use quantity	[1.47, 1.19]	[0.02***]	[0.08**]	[0.02]	[0.09**]	[0.06]
Marijuana use rates	20%	0.08***	1.60**	0.69	2.29***	1.66***
Cocaine use rates	3%	0.03	1.31	0.63	2.18	0.92
Other drug use rates	5%	0.06***	1.22	0.65	1.92	2.23**
Any drug use frequency	[3.56, 1.27]	[0.04***]	[0.07**]	[−0.09**]	[0.15***]	[0.10**]
BSI depression total	[11.75, 5.29]	[0.02***]	[0.10**]	[0.02]	[0.04]	[0.06]
SDQ emotional problems	[2.45, 2.12]	[0.02***]	[0.06]	[0.10**]	[0.06]	[0.00]
SDQ conduct problems	[2.79, 1.70]	[0.02**]	[0.09**]	[−0.01]	[0.08**]	[0.06]
SDQ hyperactivity problems	[4.45, 2.04]	[0.04***]	[0.10**]	[−0.05]	[0.16***]	[0.08**]
SDQ pro-social behavior	[5.99, 2.43]	[0.01**]	[−0.03]	[0.04]	[−0.02]	[0.10**]

SURPS, Substance Use Risk Profile Scale; SDQ, Strengths and Difficulties Questionnaire; SD, standard deviations; R, revised; coefficients show unique effects of personality traits, as all 4 personality traits are entered simultaneously into each model; Age, gender, ethnicity, and baseline scores were included as covariates: Male gender was associated with lower drinking frequency ($\beta = -0.07$, $p < 0.01$), binge drinking (OR = 0.62, $p < 0.01$), and drinking problems (OR = 0.56, $p < 0.001$) rates, lower depression ($\beta = -0.23$, $p < 0.001$), emotional problems ($\beta = -0.16$, $p < 0.001$), hyperactivity ($\beta = -0.09$, $p < 0.01$), and pro-sociality ($\beta = -0.16$, $p < 0.001$); White British adolescents reported higher increases in drinking frequency ($\beta = 0.18$, $p < 0.001$), binge drinking (OR = 3.31, $p < 0.001$), drinking problems (OR = 1.86, $p < 0.001$), and smoking quantity ($\beta = 0.07$, $p < 0.01$); age was not significantly associated with any variable. Finally, all baseline measures were significantly associated with outcome measures 18 months later, with betas ranging from 0.28 (for pro-sociality) to 0.46 (for drinking frequency) and odds ratios ranging from 3.77 (for drinking problems) to 14.34 (for marijuana use).

Significance level: ***$p < 0.001$, **$p < 0.01$.

Table 4. ROC Curve of Baseline SURPS Subscales in the Prediction of Substance Use, Emotional, and Behavioral Symptoms Within the Next 18 Months (by Time 4) in the Overall Sample ($N = 1,057$)

	Hopelessness		Anxiety sensitivity		Impulsivity		Sensation seeking-R	
	AROC (95% CI)	Cutoff score	AROC (95% CI)	Cutoff score	AROC (95% CI)	Cutoff score	AROC (95% CI)	Cutoff score
Monthly binging	0.53 (0.47–0.57)	16.0	0.49 (0.44–0.54)	13.4	**0.65 (0.60–0.70)**	13.8	**0.57 (0.53–0.59)**	15.5
Drinking problems	**0.62 (0.59–0.65)**	13.0	0.51 (0.47–0.55)	12.8	**0.65 (0.62–0.67)**	13.8	0.53 (0.49–0.56)	15.5
Smoking	**0.59 (0.53–0.65)**	13.0	0.55 (0.49–0.61)	12.8	**0.65 (0.59–0.70)**	13.8	0.54 (0.48–0.60)	16.1
Drug use	**0.57 (0.53–0.61)**	12.5	0.42 (0.37–0.50)	13.0	**0.66 (0.63–0.69)**	13.8	**0.60 (0.54–0.67)**	15.5
BSI depression	**0.66 (0.62–0.70)**	13.0	**0.59 (0.55–0.63)**	12.8	**0.63 (0.58–0.67)**	13.9	0.51 (0.47–0.55)	16.1
Emotional problems	**0.62 (0.57–0.67)**	13.0	**0.70 (0.65–0.74)**	12.8	**0.58 (0.53–0.63)**	13.5	0.48 (0.43–0.54)	15.5
Conduct problems	**0.59 (0.56–0.63)**	15.2	0.51 (0.48–0.55)	12.8	**0.74 (0.71–0.77)**	13.8	**0.55 (0.51–0.58)**	15.5
Hyperactivity problems	**0.59 (0.55–0.63)**	15.3	0.54 (0.50–0.58)	12.8	**0.71 (0.68–0.75)**	13.9	**0.57 (0.53–0.61)**	15.5

ROC, receiver operating characteristics; SURPS, Substance Use Risk Profile Scale; AROC, area under the ROC curve; CI, confident intervals; R, revised; results in boldface indicate significance levels of <0.01; CI that do not cross 0.50 are significant; cutoff values are those suggested by coordinates on each ROC curve, that is, cutoff points at which sensitivity and specificity are maximized.

personality factors, particularly IMP, SS, and H, are significant concurrent and predictive correlates of alcohol and drug use problems among North American young adolescents and adults (Conrod et al., 2006, 2010; Krank et al., 2011). Concurrent and predictive validity analyses also showed, for the first time, that these factors are important correlates of other emotional and behavioral problems in adolescence. The 4 SURPS subscales explained significant variance in all problem indicators, after controlling for gender, age, and ethnicity, at baseline as well as 18 months later (even after controlling for baseline substance use or symptom measures). Findings were mostly consistent with our hypotheses: IMP was the most consistent and strongest predictor of the substance use indicators as well as most other problems, especially those related to conduct and hyperactivity problems, identifying it as factor associated with general deviance proneness and externalizing symptomatology (Krueger et al., 2002; Sher and Trull, 2002); H was shown to have a specific and strong association with depression symptoms, but was also identified as a general vulnerability factor for most problems; SS was associated with early onset drinking and general drug use, but did have a small effect on other problem outcomes; and while AS was shown to predict greater emotional symptoms (e.g., fear, worrying a lot) over time, it was associated with reduced substance use outcomes in young adolescence.

We also examined the utility of this scale as a screening tool for selecting adolescents at future risk for problems. Overall,
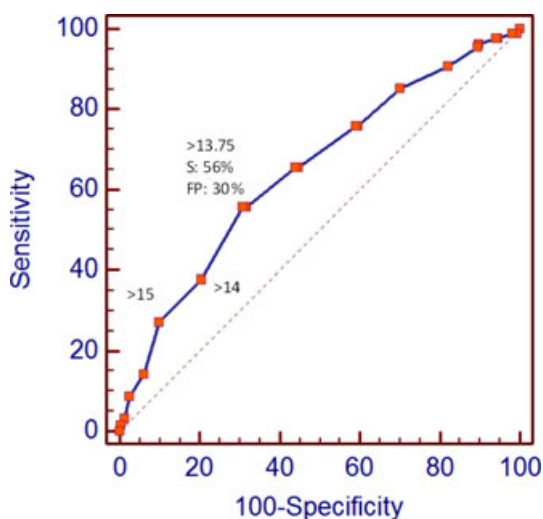
Fig. 1. Receiver operating characteristics curve of impulsivity scores predicting drinking problems within 18 months. *S*, sensitivity; FP, false-positive rate.

consistent with our hypotheses, AROC values were significantly greater than what would be expected by chance, and sensitivity analyses showed that when using the 4 SURPS subscales to identify the adolescents "at risk," one will identify up to 91% of those who will develop the problems. As expected, greater specificity was obtained when using the individual personality subscales, falsely identifying from 15 to 30% of adolescents as high risk. Considering that the SURPS does not ask adolescents to report on substance use or problem behavior directly (as most screening tools do, e.g., AUDIT, SSI-SA, and CAGE) and therefore can assess risk prior to onset of these behaviors, these are very promising results. Those identified as high on H, IMP, and SS had about 2- to 4-fold higher odds of developing a substance-related problem in the next 18 months, compared with those scoring low on these traits. Similarly, compared with those scoring low, those identified as high on these traits had 8 times higher odds of reporting serious depression symptoms (if high in H), over 4 times higher odds of reporting serious emotional symptoms (if high on AS), and had at least 5-fold higher odds of reporting serious conduct and hyperactivity
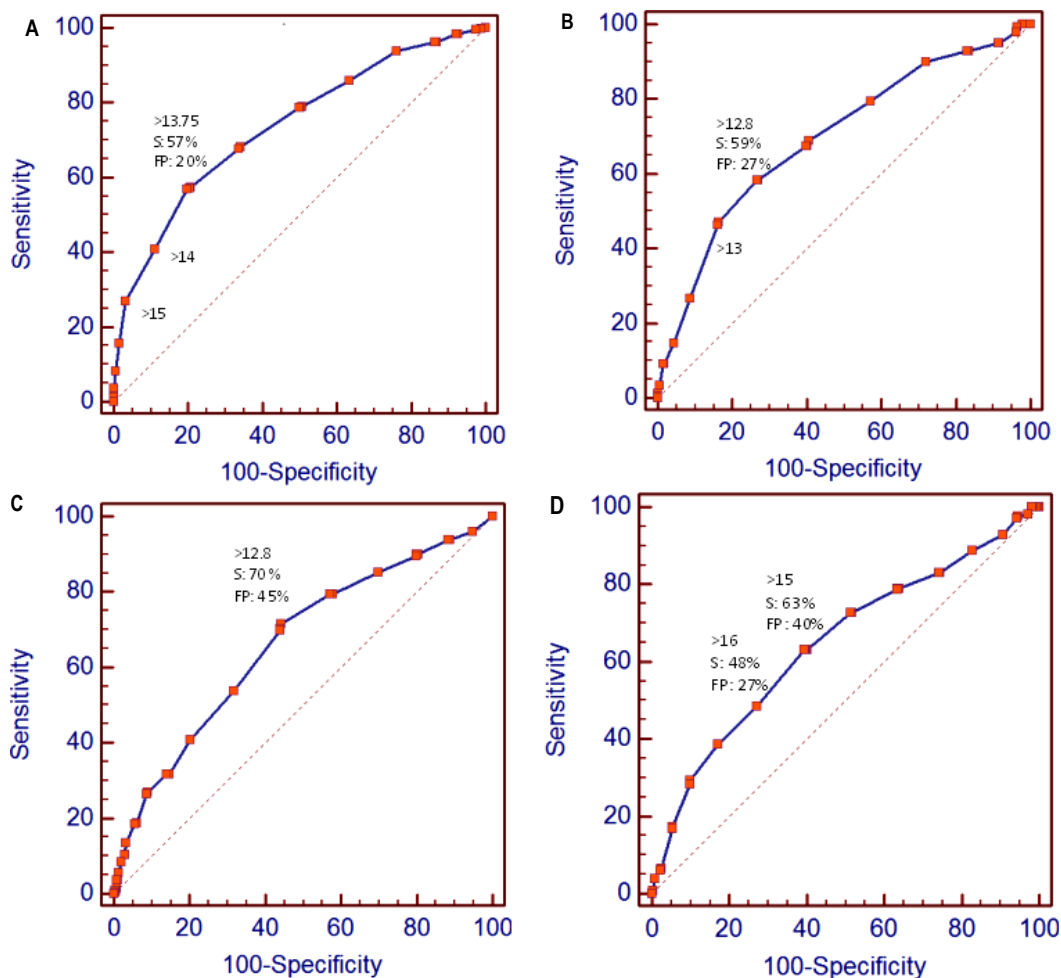

Fig. 2. Receiver operating characteristics curve of impulsivity predicting conduct problems (**A**), anxiety sensitivity predicting emotional problems (**B**), hopelessness predicting depression scores (**C**), and sensation seeking predicting drug use (**D**) within 18 months. *S*, sensitivity; FP, false-positive rate.

Table 5. Sensitivity and False-Positive Rates (1-Specificity) of the Baseline SURPS Subscales in the Prediction of Substance Use, Emotional, and Behavioral Symptoms Within the Next 18 Months (by Time 4) in the Overall Sample (N = 1,057)

%	Hopelessness	Anxiety sensitivity	Impulsivity	Sensation seeking-R	Selecting HR adolescents based on ROC cutoffs	Selecting HR adolescents (1 SD > mean cutoffs)[a]
	S, FP	S, FP	S, FP	S, FP	S, FP	S, FP
Monthly binging (13%)	20, 12	27, 31	61, 32	48, 30	72, 49	70, 42
Drinking problems (17%)	49, 34	32, 31	55, 31	36, 30	84, 63	75, 53
Smoking (9%)	61, 49	33, 30	55, 33	38, 30	81, 65	72, 55
Drug use (21%)	60, 49	27, 22	54, 30	43, 28	91, 75	74, 52
BSI depression (23%)	54, 31	42, 28	51, 30	34, 30	91, 70	73, 47
Emotional problems (13%)	54, 34	59, 27	46, 34	32, 31	91, 72	80, 53
Conduct problems (41%)	26, 13	33, 29	58, 20	35, 28	77, 50	72, 46
Hyperactivity problems (32%)	26, 15	37, 28	58, 25	38, 28	78, 55	74, 49

S, sensitivity; FP, false-positive rate; HR, high risk; R, revised; ROC, receiver operating characteristics; BSI, Brief Symptom Inventory; AROC, area under the ROC curve. Sensitivity and specificity rates were similar in the prediction of new cases of substance use problems (i.e., analyses focusing on adolescents who reported not engaging in these substance use behaviors at baseline): Impulsivity significantly predicted new cases of monthly binging (AROC = 0.61; 95% CI, 0.55 to 70; S = 55, FP = 29), drinking problems (AROC = 0.60; 95% CI, 0.53 to 0.66; S = 45, FP = 28), smoking (AROC = 0.63; 95% CI, 0.55 to 70; S = 48, FP = 32), and drug use (AROC = 0.63; 95% CI, 0.59 to 0.68; S = 49, FP = 30); hopelessness significantly predicted new cases of drinking problems (AROC = 0.61; 95% CI, 0.54 to 67; S = 51, FP = 32) and smoking (AROC = 0.59; 95% CI, 0.52 to 0.66; S = 47, FP = 35); sensation seeking significantly predicted new cases of drug use (AROC = 0.62; 95% CI, 0.57 to 66; S = 45, FP = 27).

[a]When using all 4 subscales to predict new cases: monthly binging (S = 65, FP = 53), drinking problems (S = 68, FP = 50), smoking (S = 67, FP = 54), and drug use (S = 68, FP = 49).

problems (if high in IMP). Thus, if one is interested in identifying as many adolescents at higher risk of developing problems as possible, then selecting high-risk adolescents across each of the 4 subscales is the appropriate method of selection. As false-positive rates are from 50 to 75% when using cutoffs suggested by ROC curves, this method would be more appropriate for use in broad prevention strategy targeting general coping skills, mental health, and drug-refusal skills. Furthermore, although ROC curves suggest cutoffs for IMP and H that are closer to the population mean than 1 SD above the mean for some outcomes, we recommend the use of norm-based cutoffs (i.e., scoring 1 SD above the sample mean) for the following reasons: (i) at a practical level, selecting those scoring 1 SD above the mean would be relevant and easily applied to new populations and would select from 40 to 60% of the sample, as opposed to 78%, and (ii) at a scientific level, this method would still result in acceptable sensitivity (~70%), with a more acceptable specificity (~45 to 58%).

When making decisions about cutoffs, the potential benefits of the program against any potential harm in mislabeling a child should always be carefully considered, and the ROC diagrams provide guidance for such decision making. If selecting those who have higher level of risk of developing a particular problem (specificity) is the main reason for using this screening instrument (e.g., when delivering personality-targeted interventions), then using the specific cutoffs on a particular subscale is the recommended method. Furthermore, one might favor high specificity over high sensitivity if feedback is provided to respondents or their caregivers. In this case, we would recommend using more conservative cutoff scores for IMP and H (equivalent to 1 SD above the mean). By contrast, when it is more important to identify a large number of adolescents who may develop problems (sensitivity), and the intervention does not involve personalized feedback or any potential negative conse-

quences to labeling, then a less-conservative cutoff is recommended (using the ROC curve cutoffs for IMP and H that are closer to the mean).

One potential limitation of this study is that all data were gathered through self-report, which is susceptible to bias and may limit the experimental validity of the data. However, several studies have shown that self-reports are reliable when assessing conduct disorder symptoms and substance use (e.g., Clark and Winters, 2002; Crowley et al., 2001) and hence are useful for treatment and research. This, together with guaranteed confidentiality to participants, should contribute to the reliability of these data and results. Second, this study did not include other more widely used personality measures with which to compare the SURPS subscales and thus help further validate their construct in a young adolescent sample. This said, the SURPS has been previously shown to have incremental validity over the NEO–FFI in predicting substance use behaviors in a young adults sample (Woicik et al., 2009). Another limitation was that the ROC analyses do not account for the overlap or interaction between the personality scales. Although only 25% of the sample scored high on more than 1 subscale, additive or interaction effects may account for high false-positive rates when using the 4 scales together to identify adolescents at high risk. Assessing any additive and interaction effects between these scales is worthy of future analyses. Finally, although ethnically diverse, adolescents in the present study were similar in age and from a large urban area in the United Kingdom. Findings from this study are similar to those found in a Canadian sample of adolescents (Krank et al., 2011), but further studies assessing developmental differences and cross-national replications are still needed.

Despite these limitations, the present findings provide strong support for good concurrent and predictive validity of the SURPS in young adolescents. By just asking adolescents

Table 6. Odds Ratios for Substance Use, Emotional, and Behavioral Symptoms Within the Next 18 Months (by Time 4) by Personality Subscale Cutoffs ($N = 1,057$)

Cutoff score	High hopelessness (n = 530) OR (95% CI)		High anxiety sensitivity (n = 327) OR (95% CI)		High impulsivity (n = 371) OR (95% CI)		High sensation seeking-R (n = 329) OR (95% CI)	
	>13 vs. All	vs. LR	>12.8 vs. All	vs. LR	>13.8 vs. All	vs. LR	>15.5 vs. All	vs. LR
Monthly binging	1.01 (0.69–1.47)	0.88 (0.52–1.50)	0.72 (0.47–1.10)	1.13 (0.68–1.87)	**2.47 (1.49–4.10)**	**3.35 (2.28–4.93)**	1.17 (0.78–1.76)	**1.60 (1.05–2.51)**
Drinking problems	**1.78 (1.28–2.49)**	**3.41 (1.82–6.42)**	1.02 (0.72–1.45)	1.47 (0.96–2.27)	**2.80 (2.01–3.91)**	**4.51 (2.62–7.74)**	1.30 (0.93–1.83)	**1.71 (1.12–2.62)**
Smoking	1.61 (1.04–2.50)	**3.11 (1.31–7.41)**	1.04 (0.66–1.63)	1.29 (0.75–2.23)	**2.42 (1.57–3.72)**	**3.62 (1.79–7.31)**	1.39 (0.90–2.15)	1.58 (0.93–2.68)
Drug use	**1.34 (1.00–1.80)**	**2.68 (1.56–4.61)**	0.79 (0.57–1.10)	1.19 (0.80–1.77)	**2.76 (2.04–3.74)**	**4.89 (2.97–8.05)**	**1.98 (1.42–2.62)**	**2.24 (1.52–3.20)**
BSI depression	**2.97 (2.18–4.06)**	**8.60 (4.26–17.36)**	**1.54 (1.21–2.12)**	**2.79 (1.88–4.15)**	**2.54 (1.88–3.42)**	**6.45 (3.80–10.94)**	1.33 (0.95–1.85)	**2.39 (1.58–3.62)**
Emotional problems	**2.11 (1.44–3.08)**	**4.71 (2.13–10.43)**	**3.40 (2.36–4.89)**	**4.53 (2.77–7.48)**	**1.60 (1.11–2.31)**	**2.01 (1.19–3.41)**	1.14 (0.78–1.63)	**2.47 (1.45–4.23)**
Conduct problems	**1.55 (1.22–1.99)**	**2.55 (1.72–3.76)**	1.22 (0.93–1.58)	**1.99 (1.45–2.74)**	**5.41 (4.11–7.12)**	**6.89 (4.79–9.91)**	**1.41 (1.08–1.83)**	**2.27 (1.66–3.12)**
Hyperactivity problems	**1.48 (1.13–1.93)**	**2.62 (1.67–4.10)**	**1.40 (1.06–1.86)**	**2.27 (1.59–3.23)**	**4.14 (3.12–5.48)**	**5.55 (3.67–8.39)**	**1.56 (1.18–2.07)**	**2.45 (1.71–3.46)**

Results in boldface indicate significance levels of <0.01; LR, low risk, that is, those who score below norm-based cutoffs on all traits; All, all those who scored below the cutoff on that particular trait, regardless of whether they scored above norm-based cutoffs on other personality traits; age, gender, and ethnicity were included as covariates; ORs represent general effects, as personality variables were entered separately into each model; R, revised; BSI, Brief Symptom Inventory.

about their personality, without asking about a single problem behavior, one can identify a large number of adolescents who will develop specific emotional and behavioral problems, providing strong support for the use of the SURPS to detect high-risk adolescents who might most benefit from personality-targeted or other tailored prevention approaches.

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