Title: The Impulsive Sensation Seeking (ImpSS): Psychometric properties and predictive validity regarding substance use with Spanish Adolescents

Authors: Fernández-Artamendi, S.[1]., Martínez-Loredo, V.[2], Fernández-Hermida, J.R.[2], Carballo-Crespo, J.L.[3], & García-Rodríguez, O.[2]

Affiliations

1. Biomedical Research Networking Centre on Mental Health (CIBERSAM). Department of Psychiatry. University of Oviedo. Spain
2. Addictive Behaviors Research Group. Department of Psychology. University of Oviedo. Spain
3. Miguel Hernández University. Elche, Alicante. Spain

Corresponding author:

Sergio Fernández-Artamendi, Ph.D.

CIBERSAM. Department of Psychiatry. C/Julian Clavería, s/n. 33006, Oviedo (Asturias), Spain

E-mail: sfernandezartamendi@hotmail.com

Abstract (200): The study of impulsivity and sensation seeking in adolescence is crucial given its implication in multiple risk behaviors. The present study aims to analyze the psychometrics and factorial structure of the Impulsive Sensation Seeking (ImpSS) scale with a big sample of adolescents from the general population, calculating the concurrent validity with the Barratt Impulsivity Scale (BIS-11-A) and predictive validity with the use of different substances. A total of 1321 students participated in the study (mean age: 12.98 y.o.; 55,3% male). Results indicated that the ImpSS has high reliability (α = .83), as well as predictive validity regarding tobacco, cannabis and excessive alcohol use. Factorial analyses determined that a two-factor structure is the most adequate. Nevertheless, high correlation between subscales (.69) suggests

an important second-order factor of Impulsive Sensation Seeking. Our results indicate that the ImpSS is a valid and reliable instrument to assess impulsive sensation seeking in adolescents, and shows good predictive validity regarding substance use.

Keywords: Impulsivity, Sensation Seeking, ImpSS, Adolescence, Alcohol, Tobacco, Cannabis

1. Introduction

If there is a period in life typically associated with sensation seeking (SS), that is adolescence. Zuckerman (1969) hypothesized that sensation seeking increases from early childhood and peaks during adolescence, decreasing thereafter until the older ages. Accordingly, some recent studies have reported a significant increase in SS during early childhood and adolescence (Collado, Felton, MacPherson, & Lejuez, 2014; Romer & Hennessy, 2007), to remain stable or decrease steadily thereafter (Romer & Hennessy, 2007; Roth, Schumacher, & Brahler, 2005; Steinberg et al., 2008).

Zuckerman described SS as "a trait defined by the seeking of varied, novel, complex and intense sensations and experiences, and the willingness to take physical, social, legal and financial risks for the sake of such experience" (Zuckerman, 1994). According to the notion of Optimum Level of Stimulation (OSL), each individual has a specific level of stimulation they feel most comfortable with. If individuals fall below (or over) their optimum threshold, they will seek (or avoid) new stimulation in the environment.

One recurrent way for adolescents to seek sensations is substance use. Accordingly, the onset of drugs use for the majority of the population in Western countries takes place during the age period comprised between 10 and 20 years of age (European Monitoring Centre for Drugs and Drug Addiction, 2014; Swendsen, Burstein, Case, & et al., 2012; United Nations Office on Crime and Drugs, 2012). Sensation seeking has been consistently linked to substance use (Roberti, 2004), and this association has been particularly confirmed in early and middle adolescents (Kong et al., 2013; Martin et al., 2002) and in young adults (Gonzalez-Iglesias, Gomez-Fraguela, Gras, & Planes, 2014). SS has biological roots (Zuckerman & Kuhlman, 2000) that would make it a mediator in the relationship between puberty and drug use (Martin et al., 2002). At the same time, the relationship between SS and substance use would be mediated by associations with drug-using peers (Yanovitzky, 2005, 2006), positive attitudes toward

substance use (Puente, Gutierrez, Abellan, & Lopez, 2008) and favorable affect associated with the activity (Romer & Hennessy, 2007).

The appropriate assessment of SS is crucial given its determinant role in the appearance of many risk behaviors such as substance use (Roberti, 2004), and more specifically during adolescence. Traditionally, the SSS-V (Zuckerman, Eysenck, & Eysenck, 1978) has been considered a standard method for the assessment of sensation seeking, and it has been widely utilized in multiple studies (Ferrando & Chico, 2001). Nevertheless it has been criticized for including items related to alcohol and drug consumption, sexual behaviors and physical activities that might limit its utility with different cultural and age groups. Arnett (1994) developed the Arnett Inventory of Sensation Seeking (AISS) as an alternative to overcome some of these limitations, excluding age-related items and specific questions regarding risk behaviors. The AISS measures essentially the same dimension as the SSS-V (Ferrando & Chico, 2001) but it has also received critics due to its low internal consistency (Roth, 2003; Zarevski, Marušić, Zolotić, Bunjevac, & Vukosav, 1998) and because some items might not be significantly contributing to the evaluation of the sensation seeking construct (Ferrando & Chico, 2001).

One robust alternative to measure sensation seeking in a broader framework that includes impulsivity is the Impulsive Sensation Seeking (ImpSS), a subscale of the Zuckerman-Kuhlman Personality Questionnaire (ZKPQ, Zuckerman, Kuhlman, Joireman, Teta, & Kraft, 1993). The ImpSS scale includes 19 items and evaluates the preference for change and uncertainty as well as a tendency to act without thinking or planning. Eight of these items belong to the subscale labeled “Impulsivity”. The other eleven are part of the subscale evaluating “Sensation Seeking”; eight of which are adapted from the SSS-V. The ImpSS is a brief alternative measure to evaluate impulsive sensation seeking that has shown good reliability with Cronbach’s α ranging between .84 and .87 (McDaniel & Mahan, 2008). Moreover, the ImpSS has shown to have good concurrent validity with the SSS-V and even a more favorable predictive validity than the latter regarding some high-risk behavioral correlates (McDaniel & Mahan, 2008).

Despites its strengths, the ImpSS is still underused by the research community when compared to other traditional instruments such as the SSS-V, which has a greater length and has shown lower reliability and some theoretical inconsitencies (McDaniel & Mahan, 2008). The ImpSS has been translated into Spanish as part of the Zuckerman-Kuhlman Personality Questionnaire (ZKPQ-III) by Gutiérrez-Zotes, Ramos Brieva and Saiz Ruiz (2001), and it has been used in several studies with Spanish samples thereafter (e.g. Aluja, García, & García, 2004; Montserrat Goma-i-Freixanet & Valero Ventura, 2008; Gutiérrez-Zotes et al., 2001; Romero, Luengo, Gomez-Fraguela, & Sobral, 2002). In one of the scarce studies of the psychometrics of the ZKPQ with Spanish adolescents (Romero et al., 2002), the ImpSS subscale showed a good realiability of $\alpha = .78$. This is very similar to the .77 (Robbins & Bryan, 2004) or .76 (Capone & Wood, 2009) found in other studies with English-speaking adolescents.

Given the promising role of the ImpSS as a robust assessment tool for impulsive sensation seeking, we considered necessary to conduct a thorough analyses of the structure and psychometrics of the scale. We carried out a factorial analysis of the structure of the Spanish version of the ImpSS in a sample of adolescents. Afterwards, we analyzed its reliability and predictive validity regarding a key risk behavior correlate of SS as it is substance use. Additionally, we included in this study the Spanish version (Cosi, Vigil-Colet, Canals, & Lorenzo-Seva, 2008) of the Barratt Impulsiveness Scale 11-A (BIS-11 A, Fossati, Barratt, Qcquarini, & Di Ceglie, 2002) to evaluate the concurrent validity of the ImpSS.

2. Method

2.1. Participants

A total of 1321 students from 16 secondary schools in Asturias, Spain, participated in the study. Selection of schools was performed following a random stratified and incidental procedure. To control for age effects, only data from those adolescents between 12 and 14 years of age was utilized in the study. Eventually, 1236 participants were retained for the analyses. The Oviedo Infrequency Scale (Fonseca-Pedrero, 2009) was used to discard those questionnaires with

inconsistent responses or those completed in an erratic manner. Following the rules established by the authors, questionnaires from 53 participants were finally excluded. Therefore, the final sample was made up with 1183 participants (55.3% male), with a mean age of 12.98 years old (SD = 0.54). Participation in the study was voluntary and none of the students refused to participate. The study was approved by the Ethics Committee of the Secretary of State of Research and Innovation, the local educational authorities and the participating schools.

2.2. Procedure

All questionnaires were computerized and adapted to an electronic tablet framework (Samsung Galaxy Tab2 10.1). The software allows for an automatic detection of blank responses, suggesting the participant to review them. It also prevents the system from presenting participants with unnecessary or incongruent questions based on previous answers. Participants were given guarantees of total confidentiality and anonymity.

Participants filled out the questionnaires during school time, in their own classroom and in a single session. Only a specifically-trained researcher supervised the session and no teaching staff was present.

2.3. Measures

2.3.1. Sociodemographic information: The questionnaire included questions on basic sociodemographic data including age and gender.

2.3.2. The Oviedo Infrequency scale (INF-OV) was used to detect questionnaires completed in an erratic manner or at random (Fonseca-Pedrero, 2009). A total of 12 items are mixed with other questions throughout the questionnaire asking about obvious questions such as ‘I know people who wear glasses”. Following the rules established by the authors, participants providing three or more wrong answers were excluded from further analyses.

2.3.3. Impulsive Sensation Seeking (ImpSS). The Spanish version of the Impulsive Sensation Seeking from the Zuckerman-Kulhman Personality Questionnaire

(ZKPQ, Zuckerman et al., 1993) was used. This subscale has 19 true/false (false 0, true 1) items which provide a general score and two sub-scores: Impulsivity (Imp) and Impulsive Sensation-Seeking (SS). The scale evaluates the preference for change and uncertainty, as well as the tendency to act without thinking or planning. The questionnaire avoids using items related to specific behaviors that would limit its suitability for different contexts and cultures. The internal consistency of the ImpSS as a subscale of the ZKPQ was acceptable (Cronbach's $\alpha = .78$) when used with Spanish adolescents (Romero et al., 2002). Subscales showed more moderate reliabilities (α Imp = .62 and α SS = .78).

2.3.4. Barratt Impulsivity Scale. The Spanish version (Cosi et al., 2008) of the BIS, version 11 (BIS-11-A, Fossati et al., 2002) was used. It includes 30 items with Likert-type responses on the frequency of several impulsive behaviors (1 if rarely or never, 2 if occasionally, 3 if often or 4 if almost always or always). The BIS-11-A consists of two subscales: general (BIS-g) and non-planning (BIS-np). Its validation with Spanish adolescents showed a good reliability with a Cronbach's Alpha of .87 (Martínez-Loredo, Fernández-Hermida, Fernández-Artamendi, Carballo-Crespo & García-Rodríguez, 2015)

2.3.5. Substance use. Prevalence of alcohol, tobacco and cannabis use in the last month was evaluated using the items from the ESPAD (European School Survey Project on Alcohol and Other Drugs, 2007).

2.3.6. Excessive drinking. Participants were asked about the frequency of intoxication episodes and binge drinking in the last month. Regarding binge drinking (BD), it was defined as the consumption of 5 or more standard drink units (SDUs) -4 or more for girls- on a single period of two hours (Parada et al., 2011). In order to increase accuracy, the computerized software asked participants to tap the maximum amount and the type of drinks used in a two-hour period and then automatically calculated SDUs.

2.3.7. Problem drinking. The presence of alcohol-related problems was evaluated using the Spanish version (López-Nuñez, Fernández-Artamendi, Fernández-Hermida, Campillo-Álvarez, & Secades-Villa, 2012) of the Rutgers Alcohol Problems Index (RAPI, White & Labouvie, 1989). This version has shown high reliability (Conbrach $\alpha = .91$) with adolescents. The self-report includes 23 questions with Likert-type responses (from 0 to 3) on the frequency of several alcohol-related events occurred in the previous year. A cut-off score of 7 points is suggested by the Spanish adaptation as indicative of alcohol abuse and alcohol-related problems.

2.4. Data analysis

Descriptive analyses were carried out for each one of the items of the ImpSS. An Exploratory Factor Analysis was performed using as input the matrix of polychoric correlations between items (based on scores provided by the Bartlett's Sphericity Test and the Kaiser-Meyer-Olkin Index). The extraction method used was Unweighted Least Squares (ULS) with Promin rotation and the number of factors was determined by Optimal Implementation of Parallel Analyses (PA, Timmerman & Lorenzo-Seva, 2011) with 1,000 resampling operations. The goodness-of-fit of the data to the model was established through percentage of total variance explained by the factors, the Goodness-of-Fit Index (GFI) and Root Mean Square of Residuals (RMSR).

Analyses of reliability and predictive validity were also carried out. For the reliability analyses the Cronbach's alpha was calculated for the whole ImpSS scale and for the subscales. Binary logistic regressions were performed to assess predictive validity of the ImpSS regarding substance use and alcohol-related problems. Subsequently, receiver operating characteristic (ROC) curve was analyzed in order to determine the optimum cut-off point for maximizing the sensitivity and specificity of the ImpSS to detect the presence of intoxication episodes, binge drinking and problem drinking. Data analyses were carried out with SPSS 19.0 and FACTOR 9.2 (Lorenzo-Seva, 2006).

3. Results

3.1. Descriptive statistics

The mean total score of the ImpSS in the current sample was 8.99 (*SD* = 4.41), and there were no significant differences between males (*M* = 8.87; *SD* = 4.30) and females (*M* = 9.15; *SD* = 4.55), t_{1181} = -1.09, *p* = .276. Table 1 shows the results of the descriptive analysis of each of the items.

Last month prevalence of alcohol, tobacco and cannabis use was 18.9%, 6.6% and 3.6%, respectively. Regarding last month intoxication episodes, 3.9% of participants referred getting drunk at least once in the last thirty days; and 2.3% of females and 2.4% of males referred at least an episode of binge drinking in this time period. Finally, the mean score of the RAPI among last year drinkers was 1.86 (*SD* = 5.90), and 4.1% presented with problem drinking according to the RAPI cut-off score.

---- Insert Table 1 here ----------

3.2. Factor structure

The Kaiser-Meyer-Olkin Index value was .889 and the Bartlett Sphericity test was statistically significant ($\chi^2_{(171, 1183)}$ = 4331.7, *p* < .001). Parallel Analyses recommended the extraction of two factors with a total variance explained of 48.79% (37.04% factor I and 11.75% factor II). Values of both GFI (.99) and RMSR (.049) showed a good fit of data. Factor weights of the factor items ranged from .30 to .85 (table 2). The items loading in factor I were related to Sensation-Seeking and those loading in factor II were related to Impulsiveness. Items 8, 10 and 17 showed higher loads on the factors not corresponding to their subscale. Therefore, items 8 and 17 had higher loads in the SS factor, whereas item 10 had a higher load in the Imp factor. The factor loadings of these items on their corresponding subscales was lower than .30. Correlation between both factors is considerably high and suggests the clear presence of a second-order factor of Impulsive Sensation-Seeking (*r* = .69).

---- Insert Table 2 here ----------

3.3. Reliability

The Cronbach's alpha for internal consistency of the ImpSS was moderate, with $\alpha = .83$. The internal consistency of the original subscales of the ImpSS was $\alpha = .74$ for SS and $\alpha = .75$ for Imp. Regarding homogeneity, all items except 4,5 and 10 had an item-test correlation higher than .30. Nevertheless, the internal consistency did not increase significantly when any of those items were removed. These results are indicating that all ImpSS items have a good discriminative power and contribute significantly to the total and partial scores.

3.4. Predictive validity

The results of logistic regressions indicated a significant predictive power of ImpSS for last month substance use and heavy drinking. More specifically, the ImpSS presented odds ratios of 1.159 for alcohol (CI95%: 1.119-1.202, $p \leq .001$), 1.306 for tobacco (CI95%: 1.224-1.394, $p \leq .001$) and 1.265 for cannabis use (CI95%: 1.165-1.374, $p \leq .001$). Regarding heavy drinking, the ImpSS showed an odds ratio of 1.297 (CI95%: 1.195-1.407, $p \leq .001$) for last month intoxication episodes, 1.410 (CI95%: 1.211-1.642, $p \leq .001$) for BD among males and of 1.242 (CI95%: 1.069-1.444, $p < .05$) among females. Finally, logistic regression showed an odds ratio of 1.282 (CI95%: 1.186-1.386, $p \leq .001$) to predict problem drinking according to RAPI.

The area under the ROC curve was .782 (CI95%: .721-.843) for the presence of intoxication episodes, .840 (CI95%: .757-.924) for BD among males, .765 (CI95%: .678-.853) for BD among females and .774 (CI95%: .710-.839) for problem drinking as measured by the RAPI. Sensitivity and specificity indexes according to this area under the curve are shown in table 3. Nonetheless, due to the high false positive rates (36.5% for intoxication episodes, 34.8% for binge drinking among males, 32.9% for binge drinking among females and 36.3% for problem drinking), a more suitable clinical approach was used for this index. With this alternative approach, we balanced the values of sensitivity and specificity in order to minimize the presence of false positives. Under these conditions, the ROC curve indicated that an ImpSS total score of

13 maximized the sensitivity and specificity of the instrument to detect intoxication episodes, with a sensitivity of 63% (CI95%: 58.8%-80.4%) and a specificity of 76.9% (CI95%: 66.1%-87.7%). Therefore, false positive rates were reduced from 36.5% to 23.1%. Regarding problem drinking, a total score of 13 showed a sensitivity of 63.3% (CI95%: 52.5%-74.1%), and a specificity of 77% (CI95%: 66.2%-87.8%). Finally, this same score showed a sensitivity of 68.8% (CI95%: 58%-79.6%) in males and 66.7% (CI95%: 55.9%-77.5%) in females for BD with a specificity of 79.3% (CI95%: 68.5%-90.1%) and 72.7% (CI95%: 71.9%-83.5%), respectively.

---- Insert Table 3 ----

3.5. Concurrent validity

Analyses of concurrent validity indicated that the ImpSS has a moderate correlation of .665 ($p \leq .001$) with the BIS. The correlation of the Imp subscale with the BIS was higher, with .720 ($p \leq .001$) than that of the SS (.468; $p \leq .001$). Regarding the BIS subscales, the BIS-g showed a higher correlation with the ImpSS (.675; $p \leq .001$) than the BIS-np (.436; $p \leq .001$). Additional correlations between subscales can be found in Table 4.

---- Insert Table 4 ----

4. Discussion

In the present study, we analyzed the psychometric properties of the Spanish version of the ImpSS with a big sample of adolescents from the general population. Our results indicate that the ImpSS has good reliability, good predictive validity regarding substance use, alcohol use and high risk drinking, as well as good concurrent validity with the BIS-11-A. Therefore, this research confirms the utility of the ImpSS as an assessment tool for impulsive sensation seeking and its potential in the research of OSL-related phenomena. The ImpSS offers a solid alternative to other measures of sensation seeking and impulsivity including both dimensions in a brief screening instrument.

The factorial analysis of the ImpSS supports its initial structure of two factors, one for Impulsivity and one for Sensation Seeking. However, our analysis indicated that in this sample items 8, 10 and 17 have higher factorial loads on the factors not corresponding to their original subscales. Items 8 ("I enjoy getting into situations where you can't predict how things will turn out") and 17 ("I often get so carried away by new and exciting things and ideas that I never think of possible complications") belonging to the original Imp subscale fall into the SS factor; whereas item 10 ("I tend to change interests frequently") belonging to the SS subscale falls into the Imp factor. To our knowledge, this is the first factor analysis of the ImpSS as an independent instrument, so further studies of the scale should analyze its structure to confirm these results. Nevertheless, the high correlation between resultant factors (.69) is indicating that both subscales are measuring very similar constructs and clearly supports the existence of a second-order factor of Impulsive Sensation Seeking. These factorial loadings could be due to cultural differences, or to the young age of our sample, younger than that used in the original study validating the structure of the ZKPQ (Zuckerman, 2002). Previous studies have shown that differential item functioning might occur associated to age (De Leo, Van Dam, Hobkirk, Earleywine, 2011).

The ImpSS scale has good reliability, with an Alpha of .83. This value is in line with previous studies with adults (M. Goma-i-Freixanet, Valero, Muro, & Albiol, 2008; Gutiérrez-Zotes et al., 2001; McDaniel & Mahan, 2008; McDaniel & Zuckerman, 2003) and adolescents (Robbins & Bryan, 2004; Romero et al., 2002; Stephenson, Hoyle, Palmgreen, & Slater, 2003), where Alpha values ranged between .77 and .87. Our study confirms that all items are contributing significantly to the robustness of the instrument, given the item-test correlations. The reliability of the subscales of the ImpSS was good with $\alpha = .74$ for the SS and .75 for the Imp.

It has been reported that the ImpSS offers good concurrent validity with the SSS-V (Zuckerman, 1996), with a correlation of .70. Our study confirms that this measure of Impulsive Sensation Seeking has also a good concurrent validity with a widely utilized measure of impulsivity, the BIS-11-A. The correlation between BIS-11 and ImpSS in our sample was .665, giving

additional support to its concurrent validity. Moreover, the correlation between the Impulsivity subscale of the ImpSS and the BIS-11-A was .720. Regarding predictive validity, previous studies have shown that the ImpSS has high predictive validity among youth regarding risk behaviors such as gambling, alcohol problems, alcohol use, cigarette smoking and high-risk sexual practices (McDaniel & Zuckerman, 2003; Robbins & Bryan, 2004; Schepis et al., 2008). Our study confirms these results and extends its predictive validity to cannabis use, intoxication episodes, binge drinking and problem drinking as measured by the RAPI. Moreover, our analyses indicate that a cut-off score of 13 in the ImpSS maximizes sensitivity and specificity to detect intoxication episodes, binge drinking and problem drinking.

Despite the strengths of this study and the considerable size of our sample, some limitations have to be noted. Firstly, all information collected was self-reported so it could be subject to errors. Nevertheless, an infrequency questionnaire was used to discard data from participants providing erratic data. The study design was cross-sectional and therefore the analyses of predictive validity and logistic regressions regarding substance have to be interpreted with caution. Future prospective studies should confirm these data. Our sample was formed by adolescents of 13 years of age so our results can be only extended to populations of similar characteristics.

Conclusions

The assessment of impulsivity and sensation seeking in early adolescents is of great importance given their roles as risk factors for further involvement in multiple risk behaviors. The present study confirms that the ImpSS is a reliable and valid instrument suitable for a quick screen of these constructs, allowing for an early detection of possible high-risk patterns of substance use in the future. The factorial analysis is indicating that the use of the subscales of the ImpSS should be interpreted with caution.

Conflicts of interest

The authors declare no conflicts of interest

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Table 1. Means and standard deviations of each ImpSS item.

Item	Mean	SD
1	0.48	0.50
2	0.19	0.39
3	0.40	0.49
4	0.49	0.50
5	0.85	0.35
6	0.28	0.45
7	0.48	0.50
8	0.37	0.48
9	0.65	0.48
10	0.24	0.42
11	0.72	0.45
12	0.62	0.49
13	0.54	0.50
14	0.48	0.50
15	0.53	0.50
16	0.58	0.49
17	0.41	0.49
18	0.36	0.48
19	0.32	0.47

Table 2. Factor weights of each item on the first-order factors and total variance explained*.

Items	Factor I SS	Factor II Imp
(1) I tend to begin a new job without much planning on how I will do it		.83
(2) I usually think about what I am going to do before doing it		.81
(3) I often do things on impulse		.74
(4) I very seldom spend much time on the details of planning ahead		.66
(5) I like to have new and exciting experiences and sensations even if they are a little frightening	.85	
(6) Before I begin a complicated job, I make careful plans		.85
(7) I would like to take off on a trip with no preplanned or definite routes or timetables	.32	
(8) I enjoy getting into new situations where you can't predict how things will turn out	.49	
(9) I like doing things just for the thrill of it	.72	
(10) I tend to change interests frequently		.30
(11) I sometimes like to do things that are a little frightening	.83	
(12) I'll try anything once	.69	
(13) I would like the kind of life where one is on the move and travelling a lot, with lots of change and excitement	.65	
(14) I sometimes do "crazy" things just for fun	.64	
(15) I like to explore a strange city or section of town by myself, even if it means getting lost	.65	
(16) I prefer friends who are excitingly unpredictable	.58	

(17) I often get so carried away by new and exciting things and ideas that I never think of possible complications	.51	
(18) I am an impulsive person		.62
(19) I like "wild" uninhibited parties	.52	
% Total variance	37.04	11.75

*Factor loadings < .30 are not shown

Table 3. ImpSS sensitivity and specificity according to the area under the ROC curve.

	Sensitivity (95% Confidence Interval)	Specificity (95% Confidence Interval)
Intoxication episodes	73.9% (63.1% - 84.7%)	63.5% (52.7% - 74.3%)
Male binge drinking	81.3% (70.5% - 92.1%)	65.2% (54.4% - 76%)
Female binge drinking	75% (64.2% - 85.8%)	67.1% (56.3% - 77.9%)
Problem drinking	75.5% (64.7% - 86.3%)	63.7% (52.9% - 74.5%)

Table 4

	BIS-11-A	ImpSS	BIS-g	BIS-np	ImpSS-SS
ImpSS	.665**	1			
BIS-g	.869**	.705**	1		
BIS-np	.798**	.436**	.436**	1	
ImpSS-SS	.468**	.898**	.496**	.270**	1
ImpSS-Imp	.720**	.854**	.705**	.516**	.537**

** $p \leq .001$