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Impulsivity facets and substance use initiation: A comparison of two models of impulsivity

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HIGHLIGHTS

- The Two-Factor Model of impulsivity predicts substance use initiation prospectively.
- The UPPS-P model shows limited evidence of predictive utility.
- Rash impulsivity and reward drive uniquely predict initiation in adolescents.

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ABSTRACT

Several types of impulsivity have been linked to various substance use outcomes. The UPPS-P framework has received major focus within the field of substance use research. However, this framework is not without limitation. An alternative framework is the Two-Factor Model of impulsivity, which posits that rash impulsivity and reward drive are the central, if not sufficient, domains of impulsivity. Unfortunately, the extant literature is quite limited in terms of work that have directly compared the UPPS-P framework to the Two-Factor Model of impulsivity, particularly in prospective designs focused on the initiation of common, problematic forms of substance use among adolescents (i.e., alcohol and marijuana use). In the current study, the UPPS-P measures were compared to dedicated measures of the Two-Factor Model of impulsivity in a sample of Chilean adolescents who were lifetime abstainers of alcohol or marijuana use at baseline ($N = 541$) to predict the initiation of use for these substances at a one-year follow-up. Results showed that the Two-Factor Model had superior predictive utility compared to the UPPS-P measures, and only rash impulsivity and reward drive were significant predictors in a multivariate model that simultaneously considered UPPS-P and Two-Factor Model assessments. Overall, the current findings indicate that the Two-Factor Model should be considered to index risk of substance use initiation to guide prevention efforts and highlight the importance of direct comparisons of alternative measurement and theoretical frameworks of impulsivity within the field of substance use research.

1. Introduction

Impulsivity is considered as an important contributor to various substance use outcomes (see Berg, Latzman, Bliwise, & Lilienfeld, 2015; Littlefield, Stevens, & Sher, 2014; Littlefield & Sher, 2016; Verdejo-García, Lawrence, & Clark, 2008). Recently, specific facets of impulsivity have been identified and linked with substance use and other substance-related outcomes. Whiteside and Lynam (2001) conducted a factor analysis of several impulsivity measures and identified four factors: (1) lack of planning (LPL), a tendency to engage in immediate action instead of careful planning; (2) lack of perseverance (LPER), difficulty in sustaining attention and staying on task, and boredom susceptibility; (3) sensation seeking (SS), a tendency to seek excitement and adventure; and (4) urgency, difficulty in resisting strong impulses and a tendency to act rashly when experiencing intense affect. Subsequently, urgency was split into two factors labeled positive (PU) and negative (NU) urgency, which differ on the valence of the affective state leading to impulsive action (Cyders et al., 2007).

The resulting impulsivity measure derived from this work (the UPPS-P; Lynam, Smith, Whiteside, & Cyders, 2006) has been extensively used in recent years to clarify the association of impulsivity facets with substance use and related problems. In a meta-analysis

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including samples of adolescents (mean age = 21.66; SD = 8.53 across studies), Coskunpinar, Dir, and Cyders (2013) found that impulsivity facets differentially related to alcohol use outcomes such as drinking quantity, drinking problems, and alcohol dependence, and that age did not moderate the effect size magnitude. In a meta-analytic review focused on adolescent alcohol use (though over half of the studies were based on college students and/or included an average age of over 18; see Tomko, Prisciandaro, Falls, & Magid, 2016), Stautz and Cooper (2013) found alcohol consumption was most associated with PU and SS and that alcohol problems had the highest relation to PU and NU.

In contrast to this line of work, Dawe and colleagues (Dawe, Gullo, & Loxton, 2004; Gullo & Dawe, 2008) proposed a Two-Factor Model of impulsivity based on behavioral and neurobiological research: reward drive (associated with increased approach impulse) and rash impulsivity (associated with decreased inhibitory control; Gullo, Loxton, & Dawe, 2014). Although they have not developed a specific measure for these constructs, reward drive and rash impulsivity have been usually assessed through the sensitivity to reward (SR) scale from the Sensitivity to Punishment and Sensitivity to Reward Questionnaire (SPSRQ; Torrubia, Ávila, Moltó, & Caseras, 2001) and the Barratt Impulsiveness Scale (BIS-11; Patton, Stanford, & Barratt, 1995), respectively (e.g., Loxton, Nguyen, Casey, & Dawe, 2008; but see Goodwin, Browne, Rockloff, & Loxton, 2016, for an alternative way of measuring sensitivity to reward). This model is consistent with the broad dual-process models of addiction, which posit that addictive behaviors are the result of two complementary systems associated with different neural substrates: (1) a bottom-up system, characterized by emotion-based drive, and (2) a top-down system, characterized by the ability to control those urges. Although some specific predictions derived from dual-process models have not been confirmed empirically (Ellingson, Vergés, Littlefield, Martin, Slutske, 2013; Ellingson et al., 2018; Littlefield, Vergés, McCarthy, & Sher, 2011), these models are still a useful heuristic tool to conceptualize impulsive traits and their relation with substance abuse.

Although the UPPS-P is currently a commonly used and well-regarded framework for assessing impulsivity-related constructs (e.g., in addition to the meta-analyses highlighted above, the National Institutes of Health's PhenX Toolkit [Hamilton et al., 2011] has endorsed the UPPS-P as the recommended self-report measure of impulsivity), emerging work suggests that this approach has several shortcomings in comparison to the Two-Factor Model of impulsivity. Gullo et al. (2014) thoughtfully described limitations of the UPPS-P framework, including that the UPPS-P was created through factor analytic work that lacks theoretical integration with other, biologically informed lines of research. Further, there is a lack of evidence supporting the incremental validity of the UPPS-P traits over models that consider fewer traits. Given these observations, work that directly compares the incremental validity of the five UPPS-P measures to the more parsimonious Two-Factor Model is warranted.

Stautz, Dinc, and Cooper (2017) examined the extent to which the facet measures of the UPPS-P predicted alcohol and cannabis use after accounting for reward drive and rash impulsivity (as well as trait neuroticism as assessed by the revised Eysenck Personality Questionnaire; Eysenck, Eysenck, & Barrett, 1985). More specifically, three studies involving undergraduate participants (total N across samples = 486) derived scores of reward drive and rash impulsivity using multiple scales (including the LPL and SS facets of the UPPS-P). Overall, findings indicated that the “three novel facets” of the UPPS-P (PU, NU, and LPER) provided limited incremental validity in predicting substance use outcomes compared to the two-component model of impulsivity, though the urgency measures accounted for unique variance in substance-related consequences.

To our knowledge, the work by Stautz et al. (2017) is the only existing study to directly pit the UPPS-P measures against assessment of the two-factor conceptualization of impulsivity. However, this work was limited on a number of fronts. For example, rather than using dedicated measures of reward drive and rash impulsivity, principal components analyses based on multiple measures (including some UPPS-P measures) were used to derive scores for these constructs. This approach creates some ambiguity regarding direct comparison between the UPPS-P assessments and measures typically used to index reward drive and rash impulsivity. Further, consistent with the larger literature, this study focused on cross-sectional data among participants who had already initiated substance use. Although the evidence of an association between multiple types of impulsivity and numerous substance use outcomes is fairly robust, the nature of these relations is clouded, given heightened levels of impulsivity can be conceptualized as a vulnerability factor or as a consequence of substance use (de Wit, 2009; Lejuez et al., 2010).

Fortunately, longitudinal studies predicting substance use initiation allow for these potential alternative explanations to be clarified (see Durbin & Hicks, 2014; Littlefield & Alquist, 2014). In the aforementioned Stautz and Cooper (2013) meta-analysis, only SS (seven studies with an aggregate effect size of $r = 0.20$) and LPL (three studies with an aggregate effect size of $r = 0.15$) had a sufficient number of studies to warrant meta-analysis of alcohol initiation. These authors identified only one study (Gunn & Smith, 2010) that examined the relation between alcohol initiation with LPER ($r = 0.10$), NU ($r = 0.20$) and PU ($r = 0.18$). Following these meta-analyses, some recent work has examined the impact of UPPS-P facets on alcohol initiation. Lopez-Vergara, Spillane, Merrill, and Jackson (2016) examined the relation between alcohol initiation and escalation with PU, NU, and trait affect. Although there were significant bivariate associations with alcohol initiation for both PU ($r = 0.29$) and NU ($r = 0.27$), these relations were reduced in magnitude and non-significant in models that included trait positive and negative affect. In a follow-up to this work, Lopez-Vergara, Merrill, Janssen, and Jackson (2017) found SS was significantly related to the likelihood of alcohol initiation (even when adjusting for several social and individual-level variables). We are only aware of one study (Willem, Bijttebier, & Claes, 2010) that reported the relation between reward sensitivity and alcohol initiation ($r = 0.17$; see also Urošević et al., 2015, for a non-significant association which magnitude is not reported).

Existing work is even more limited in regards to the relation between the impulsivity facets noted above and the initiation of use of other substances, such as marijuana. A recent meta-analysis (VanderVeen, Hershberger, & Cyders, 2016) examined relations between the UPPS-P facets and marijuana use and related consequences across thirty-eight studies, though only one study (Pang, Farrahi, Glazier, Sussman, & Leventhal, 2014) focused on marijuana use initiation. Pang et al. (2014) only examined the relation between NU and marijuana onset, though the data were cross-sectional and relied on retrospective reporting for marijuana use. NU did not significantly relate to age of onset of marijuana use among those who reported lifetime use of marijuana. To our knowledge, no other studies have tested whether initiation of marijuana use is associated with either the UPPS-P or Two-Factor Model.

In sum, there is evidence that at least some facets of impulsivity are associated with the onset of substance use, though overall the extant literature is limited on several fronts. Importantly, the UPPS-P and Two-Factor Models have not been examined simultaneously within a more comprehensive model predicting substance use onset. The purpose of the current study was to prospectively examine the relation between UPPS-P and Two-Factor Models with the initiation of alcohol and/or marijuana use in a sample of adolescents.

2. Method

2.1. Participants

The current study was conducted in the context of the Growth and Obesity Chilean Cohort Study (GOCS; Corvalán, Uauy, Stein, Kain, &

Martorell, 2009), conducted by the Institute of Nutrition and Food Technology (INTA). The GOCS was initiated in the year 2006 with a main aim of assessing the association between early weight and linear growth and BMI trajectories in preschool children, but the cohort has been followed to early adolescence, a developmental stage in which risky behaviors including substance use become prominent.

All children 2.6 to 4.0 years of age attending public nursery schools of six counties in the South East area of Santiago and who met the following inclusion criteria: 1) single births with birth weight between 2500 and 4500 g and 2) absence of physical and psychological conditions that can alter growth, were invited to participate in the study. Of the original sample of 1190 children, 851 (72%) adolescents accepted to participate in the baseline assessment of impulsivity and substance use, and 744 (87% of the baseline sample) participated in the follow-up a year later. A final sample of 541 adolescents who were lifetime alcohol and marijuana abstainers at baseline (and had non-missing values in substance use at follow-up) were included in the current analysis.

Impulsivity and substance use measures were administered together with the annual assessments that are conducted in the context of the GOCS study. The baseline assessment took place at ages 12 to 14 (mean age = 13.17; SD = 0.54). Written informed consent from parents and assent from the adolescents was obtained for all participants. All procedures for the current study were approved by the Institutional Review Board at both Pontificia Universidad Católica and INTA.

2.2. Measures

2.2.1. Impulsivity

A set of self-report questionnaires was administered by trained research assistants. To operationalize the Two-Factor Model (consistent with prior work; Loxton et al., 2008), the Barratt Impulsiveness Scale (BIS-11A; Barratt, 1994) was used as a measure of rash impulsivity, and the SR scale from the SPSRQ (Torrubia et al., 2001) was used as a measure of reward drive.

The BIS-11A is a 30-item questionnaire which includes questions focusing on motor impulsivity (acting without thinking), attention impulsivity (making quick cognitive decisions), and non-planning impulsivity (lack of concern about the future)[1]. The Chilean adaptation had an overall alpha coefficient of 0.77 in a sample of adolescents (Salvo & Castro, 2013). The alpha in the current sample was 0.71.

The SPSRQ is a 48 yes–no response item questionnaire with 24 items assessing sensitivity to punishment and 24 items assessing sensitivity to reward (one item, “Do you like to take some drugs because of the pleasure you get from them”, was deleted). The SR scale had an alpha coefficient of 0.75 and 0.78 for females and males, respectively, in the original development, and 0.72 and 0.77 for females and males, respectively, in the Chilean adaptation (Dufey, Fernández, & Mourgues, 2011). The alpha in the current sample was 0.80.

In addition to the measures of rash impulsivity and reward drive, the UPPS-P (Lynam et al., 2006) was also administered. The UPPS-P is a 59-item questionnaire measuring LPL, LPER, SS, PU, and NU. Although the UPPS-P has been shown to have good psychometric properties, several studies have put into question the original five-factor structure of the scale. Consistent with other work based on the original version (Cyders & Smith, 2007; Stevens, Littlefield, Blanchard, Talley, & Brown, 2016), factor analysis conducted in the Chilean version of the UPPS-P found that a 3-factor solution, in which LPL and LPER, as well as PU and NU, comprised single factors, better fit the data (Bussio, unpublished manuscript; see also Berg et al., 2015, for further justification of a 3-factor solution)[2]. The alpha coefficients in the current sample were 0.79, 0.82, and 0.91, for SS, LPL/LPER, and PU/NU, respectively.

2.2.2. Substance use

A set of substance use items, taken from the Chilean national studies on substance use (Observatorio Chileno de Drogas, 2015) were included to make results comparable with information from the general Chilean population. The same items were included in the assessments at baseline and follow-up. These items include questions regarding lifetime use of alcohol (“Have you had any alcohol [for example, beer/malt, chicha, wine/champagne, or strong liquors] ever in your life?”), lifetime use of marijuana (“Have you used marijuana ever in your life?”), and time since last consumption (“When was the last time that you used alcohol”, “When was the last time that you used marijuana”. Response options: 1. During the last 30 days, 2. Before the last 30 days, but during the last year, 3 Prior to the last year). Based on these items, a substance use initiation variable was created (1 = initiation of alcohol and/or marijuana use at follow-up; 0 = no lifetime alcohol/marijuana use).

2.3. Analysis

Three logistic regressions were conducted, with substance use initiation at follow-up as the dependent variable across models, impulsivity measures as independent variables, and sex and age (modeled as categorical[3]) as covariates. In Model 1 (corresponding to the Two-Factor Model of impulsivity), the BIS-11A and the SR were included as predictors. In Model 2 (corresponding to the UPPS-P model), LPL/LPER, SS, and PU/NU were included as predictors. The fit of the two models was compared using the Akaike Information Criterion (AIC), given that they are non-nested models. In Model 3, all five impulsivity variables were included as predictors to test for incremental validity of the UPPS-P (i.e., predictive contribution over and above what is already predicted by the Two-Factor Model). All analyses were conducted in SAS 9.2.

3. Results

Table 1 shows the means and standard deviations for the standardized scores of the impulsivity variables (and the raw scores for the full sample). Although a combined alcohol and/or marijuana use variable was used as the dependent variable (among other reasons, to increase power in this young sample of adolescents), data are presented for various substance use categories to enhance transparency (though will not be discussed further; see Table 1). As can be seen, abstainers were below the grand mean for all impulsivity variables, with the exception of SS. In addition, participants who reported initiation of either alcohol or marijuana use were above the grand mean for all of the impulsivity measures, with relatively higher scores for the BIS-11A and the SR scales.

Correlations involving the impulsivity measures at baseline and substance use at follow up are shown in Table 2. Statistically significant small to medium correlations were generally found among the

[1] The BIS-11A (Barratt, 1994) was used instead of the standard BIS-11 (Patton, Stanford, & Barrat, 1995) because this is the version that is currently validated in Chile (Salvo y Castro, 2013). Analyses that included a variable that retained only the 24 items that correspond to the BIS-11 (which correlated 0.97 with the 30-item variable) yielded results consistent with those noted below, with the exception of the SR becoming significant in Model 1 and the BIS-11A becoming non-significant in Model 3 (see Table 3).

[2] Analyses that included all five UPPS-P facets yielded results consistent with those noted below. In addition, factor analysis conducted during the process of validation of the Chilean version of the UPPS-P yielded a solution with fewer retained items by factor. This solution was replicated with the current sample using Confirmatory Factor Analysis (CFA). The final CFA (with one additional item deleted) indicated adequate fit to the data [$\chi^2 = 2425.6$, 1031 *df*, $p < .001$, RMSEA = .050 (90% CI = .047–.053), CFI = 0.90, TLI = 0.90]. Analyses that included the three factors with fewer items also yielded results consistent with those noted below.

[3] Analyses with age modeled as a continuous variable (number of months since birth) yielded results consistent with those noted below, with the only exception of LPL/LPER becoming significant in Model 2 (see Table 3).

Table 1
Baseline characteristics of participants by follow-up substance use report.

	Full Sample	Abstainers	Alcohol or Marijuana	Alcohol Only	Marijuana Only	Alcohol and Marijuana
N	541	456	85	49	22	14
Female, *n* (%)	273 (50.5)	227 (49.8)	46 (54.1)	27 (55.1)	13 (59.1)	6 (42.9)
Age at Baseline, *n* (%)						
12	42 (7.8)	39 (8.6)	3 (3.5)	3 (6.1)	0	0
13	366 (67.7)	307 (67.3)	59 (69.4)	33 (67.4)	18 (81.8)	8 (57.1)
14	133 (24.6)	110 (24.1)	23 (27.1)	13 (26.5)	4 (18.2)	6 (42.9)
Impulsivity Measures, *M*, (SD)[a]						
BIS-11	1.32 (0.29)	1.31 (0.29)	1.40 (0.29)	1.33 (0.25)	1.50 (0.39)	1.50 (0.17)
		−0.07 (1.01)	0.26 (1.03)	0.01 (0.89)	0.61 (1.35)	0.60 (0.59)
SR	0.38 (0.20)	0.37 (0.20)	0.43 (0.20)	0.44 (0.20)	0.44 (0.19)	0.38 (0.21)
		−0.06 (0.97)	0.23 (0.98)	0.27 (0.99)	0.30 (0.95)	−0.03 (1.04)
PU/NU	2.35 (0.42)	2.34 (0.43)	2.39 (0.38)	2.33 (0.41)	2.45 (0.37)	2.49 (0.20)
		−0.02 (1.00)	0.09 (0.88)	−0.04 (0.96)	0.24 (0.86)	0.32 (0.46)
LPL/LPER	2.24 (0.32)	2.23 (0.32)	2.31 (0.28)	2.30 (0.27)	2.30 (0.31)	2.36 (0.27)
		−0.05 (1.04)	0.19 (0.90)	0.15 (0.88)	0.17 (1.01)	0.35 (0.87)
SS	2.71 (0.46)	2.70 (0.47)	2.76 (0.39)	2.68 (0.40)	2.89 (0.33)	2.83 (0.39)
		0.02 (1.01)	0.15 (0.84)	−0.02 (0.87)	0.43 (0.72)	0.30 (0.84)

Note. The full sample corresponds to the sum of "abstainers" and "alcohol or marijuana". The "alcohol or marijuana" group corresponds to the sum of "alcohol only", "marijuana only", and "alcohol and marijuana". BIS-11A = Barratt Impulsiveness Scale; SR = Sensitivity to Reward; PU/NU = Positive and Negative Urgency; LPL/LPER = Lack of Planning and Lack of Perseverance; SS = Sensation Seeking.

[a] The means and standard deviations for the full sample are calculated from raw scores, whereas the mean and standard deviations for all other subgroups are calculated from both raw scores (above) and standardized scores (below).

Table 2
Correlations among variables.

	Age	Sex	BIS-11A	SR	PU/NU	LPL/LPER	SS	Substance Use
Age	1.00							
Sex [a]	0.01	1.00						
BIS-11A	−0.02	0.01	1.00					
SR	−0.03	0.10*	0.26*	1.00				
PU/NU	0.01	0.01	0.60*	0.39*	1.00			
LPL/LPER	0.00	−0.09*	0.50*	−0.01	0.29*	1.00		
SS	0.00	0.10*	0.19*	0.37*	0.32*	−0.09*	1.00	
Substance Use	0.05	−0.03	0.12*	0.11*	0.04	0.09*	0.05	1.00

Note. All variables are measured at baseline, except for substance use, which is measured at follow-up. BIS-11A = Barratt Impulsiveness Scale; SR = Sensitivity to Reward; PU/NU = Positive and Negative Urgency; LPL/LPER = Lack of Planning and Lack of Perseverance; SS = Sensation Seeking.

[a] Sex: 0 = female, 1 = male.

* $p < .05$.

impulsivity variables. One noticeable exception to this is the correlation between the LPL/LPER and SR scales ($r = -0.01$, $p = .76$). Also of notice is the negative correlation between LPL/LPER and SS ($r = -0.09$, $p = .03$). With regard to correlations between the impulsivity variables and substance use at follow-up, both variables used to operationalize the Two-Factor Model of impulsivity were significantly associated with substance use initiation (BIS-11A: $r = 0.12$, $p = .01$; SR: $r = 0.11$, $p = .01$), whereas of the three UPPS-P variables only LPL/LPER showed a significant association with substance use initiation ($r = 0.09$, $p = .04$; see Table 2).

Table 3 shows results from the three logistic regression models used to compare the Two-Factor and the UPPS-P models of impulsivity in terms of prediction of substance use initiation. In Model 1 (corresponding to the Two-Factor Model of impulsivity), only the BIS-11A was significantly associated with substance use initiation (OR = 2.51 [CI = 1.09, 5.79]), whereas the SR had a strong but not-significant association with substance use at follow-up (OR = 3.27 [CI = 0.97, 11.01]). The predictive contribution of both factors taken together was also significant (Wald $\chi^2(2) = 10.95$, $p < .01$). In contrast, results from Model 2 showed that none of the UPPS-P factors were significantly associated with substance use initiation. Moreover, the predictive contribution of the three factors taken together was not significant (Wald $\chi^2(3) = 5.29$, $p = .15$), and the AIC criterion indicates that the Two-Factor Model (AIC = 467.81) provided better prediction of substance use initiation compared with the UPPS-P model (AIC = 475.60).

Table 3
Logistic regressions predicting substance use initiation.

	Model 1	Model 2	Model 3
	OR (95% CI)	OR (95% CI)	OR (95% CI)
BIS-11A	2.51 (1.09, 5.79)*		1.39 (1.00, 1.93)*
SR	3.27 (0.97, 11.01)		1.37 (1.05, 1.80)*
PU/NU		0.96 (0.52, 1.78)	0.75 (0.54, 1.04)
LPL/LPER		2.18 (1.00, 4.75)	1.16 (0.88, 1.52)
SS		1.42 (0.81, 2.47)	1.06 (0.82, 1.39)
Wald χ^2 Test (*df*)	10.95 (2)*	5.29 (3)	3.97 (3)
Generalized R^2	0.05	0.03	0.06
AIC	467.81	475.60	469.78

Note. OR = Odds Ratio; CI = Confidence interval; BIS-11A = Barratt Impulsiveness Scale; SR = Sensitivity to Reward; PU/NU = Positive and Negative Urgency; LPL/LPER = Lack of Planning and Lack of Perseverance; SS = Sensation Seeking; *df* = degrees of freedom.
Generalized R^2 corresponds to the coefficient described in Nagelkerke (1991).

* $p < .05$.

Finally, Model 3 shows no evidence of incremental validity of the UPPS-P model when including predictors from both models in one logistic regression. Both the BIS-11A (OR = 1.39 [CI = 1.00, 1.93]) and SR (OR = 1.37 [CI = 1.05, 1.80]) significantly predicted substance use initiation when adjusting for the UPPS-P variables. The predictive

contribution of the three UPPS-P factors taken together was again not significant (Wald $\chi^2(3) = 3.97$, $p = .27$).

Given that the two sets of impulsivity measures show some overlap in content, additional analyses were conducted based on factor analyses of all impulsivity items. Results are presented in the Supplemental Material.

4. Discussion

Although various types of impulsivity have been linked to multiple substance use outcomes, and the UPPS-P framework has garnered substantial research attention, there is a paucity of studies comparing this framework to more theoretically derived conceptualizations of impulsivity, such as the Two-Factor Model. The current results are consistent with prior work by Stautz et al. (2017), which indicated most of the UPPS-P facets did not show incremental validity over a two-factor conceptualization of impulsivity in predicting alcohol and cannabis use in undergraduate samples. Building on these findings, the current prospective data indicated that the Two-Factor Model had better predictive utility for the onset of substance use within this adolescent sample, and that rash impulsivity and reward drive were the only significant unique predictors of initiation in a multivariate model that simultaneously considered UPPS-P and Two-Factor Model measures.

The interpretation of results in Model 3 should take into account the strong correlations among predictors, which could lead to multicollinearity. Nevertheless, the lack of significant results for the UPPS-P factors in Model 3 is probably due to the small correlations between these variables and substance use initiation (see Table 2), which is reflected in the lack of significant associations found in Model 2, where multicollinearity is less likely. Moreover, in Model 3 the BIS is still significant, in spite of the strong correlations it shows with some of the UPPS-P measures.

Although this study included multiple strengths (a relatively large sample that used a prospective design focused on the initiation of substance use among previous abstainers of alcohol and marijuana with dedicated assessment of multiple types of impulsivity), there were some limitations. First, all assessments were based on self-reported levels of impulsivity and substance use; future studies should incorporate multimethod assessments of both impulsivity (e.g., laboratory-based measures) and substance use (e.g., biomarkers of use) when feasible. Second, alcohol and marijuana initiation variables were combined into a single, binary variable to increase power and the stability of parameter estimates; future studies with even larger sample sizes could examine alcohol and marijuana initiation as separate outcomes. Third, several studies referenced involving the UPPS-P framework have utilized a modified version of the scale for adolescents (that has not been validated in Chile) and thus this should be considered when comparing the current results with prior work. Similarly, multiple measures have been used to index rash impulsivity and reward drive and thus future work may seek to replicate the current findings regarding the Two-Factor Model of impulsivity with other assessment approaches.

Regardless of these limitations, there are several important implications of the current work. One practical implication is that the Two-Factor Model should be considered to index risk of substance use initiation to guide prevention efforts. Similarly, researchers interested in examining the relation between types of impulsivity and substance use outcomes should also consider including measures of impulsivity relevant to the Two-Factor Model in addition (or as an alternative; see Gullo et al., 2014) to the UPPS-P measure. Consistent with ideas posited by Dawe and colleagues (Dawe and Loxton, 2004; Gullo et al., 2014), the current findings suggest that the BIS and SR may more closely assess the constructs of rash impulsiveness and reward drive and better predict substance use initiation than the UPPS-P. Although analyses presented in the Supplemental Material did not result in better prediction of substance initiation, further efforts should be undertaken to develop an optimal operationalization of the Two-Factor Model (though care should be taken to ensure that improvement in measurement outweighs the cost of reduced consistency with past measurement). More broadly, the current work highlights the importance of direct comparisons of alternative measurement and theoretical frameworks of impulsivity within the field of substance use research.

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Contributors

Alvaro Vergés and María Elena Alvarado designed the study. Alvaro Vergés, Andrew Littlefield, and Tomás Arriaza conducted the data analysis. All authors contributed to editing the manuscript and have approved the final manuscript.

Conflict of interest

The authors declare no potential conflicts of interest with respect to the authorship, and/or publication of this article.

Appendix A. Supplementary data

Supplementary data to this article can be found online at https://doi.org/10.1016/j.addbeh.2018.08.018.

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