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Impulsivity and history of behavioral addictions are associated with drug use in adolescents

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Abstract

Background: Previous literature suggests that trait impulsivity and engagement in non-drug-related behavioral addictions (e.g., Internet addiction, food addiction) are two risk factors for drug use. Here we further investigated the potential impact of having one or both of these risk factors on drug use in Los Angeles area adolescents.

Method: High school students (N = 1612; Mean age = 14.1) completed self-report surveys measuring two potential risk factors (impulsivity, lifetime history of several behavioral addictions), and past 6-month use of tobacco, alcohol and marijuana. Participants who reported never using drugs completed questionnaires assessing their susceptibility for future use.

Results: In general, adolescents who endorsed either impulsivity alone or at least two behavioral addictions alone were more likely to have used tobacco, alcohol, or marijuana compared to individuals who had neither risk factor (OR = 2.50–4.13), and individuals who endorsed both impulsivity and three or more behavioral addictions were the most likely to have used these drugs (OR = 9.40–10.13). Similarly, among those who had never tried a drug, individuals with this combined set of risk factors were the most likely to be susceptible to future drug use (OR = 3.37–5.04).

Discussion: These results indicate that the combination of trait impulsivity and a history of behavioral addictions increases the risk for current and future drug use in adolescents, to a greater extent than either risk factor alone. It may be useful for drug prevention efforts to target impulsive adolescents who also actively engage in other non-drug-related addictive behaviors.

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Contributors

Leventhal designed and led data collection for the larger investigation of adolescent drug use. Chuang, Stone, and Kirkpatrick developed the idea for the current study. Sussman developed the behavioral addictions questionnaire. Chuang, Stone, Chou and Kirkpatrick conducted the statistical analysis. Chuang, Stone, Pang and Kirkpatrick wrote the first draft of the manuscript. All authors contributed to subsequent drafts and have approved the final manuscript.

Conflict of interest

All authors declare that they have no conflicts of interest.

Keywords

Impulsivity; Behavioral addiction; Marijuana; Tobacco; Alcohol; Adolescents

1. Introduction

For a large proportion of the U.S. population, use of several drugs of abuse (e.g., tobacco, alcohol, and marijuana) begins in adolescence. In 2014, 4.9% of individuals aged 12 to 17 reported currently smoking tobacco (i.e. past 30-day use), 11.5% currently drank alcohol, and 7.4% currently used marijuana. Further, among these individuals the average age of initiation was approximately 15 years old (SAMHSA, 2014). In general, earlier drug use initiation in adolescents increases the likelihood of both developing a substance use disorder and difficulty quitting in adulthood (Moss, Chen, & Yi, 2014). Additionally, adolescents who use drugs are at a greater risk for having concurrent psychiatric disorders, such as affective and anxiety disorders, compared to their non-drug-using counterparts (Gil, Wagner, & Tubman, 2004). Thus it is critically important to better understand the risk factors for drug use among adolescents in order to develop better prevention strategies. Previous research has examined a wide range of potential risk and protective factors for drug use in adolescents (Sussman & Ames, 2008), including those at the individual level (e.g., the risk for smoking cigarettes is higher for adolescents with high trait hostility: Weiss, Mouttapa, Cen, Johnson, & Unger, 2011), as well as those at the social (e.g., peer tobacco, alcohol, and marijuana use is strongly associated with an individual's drug use: Bahr, Hoffmann, & Yang, 2005) and larger contextual levels (e.g., highly religious adolescents are at a lower risk for drug use compared to their non-religious counterparts: Wallace et al., 2007). In this study, we examine the impact of two potential risk factors, both alone and in combination: a history of engagement in non-drug-related addictive behaviors and trait impulsivity.

One possible risk factor for drug use is engagement in one or more non-drug-related addictive behaviors (e.g., gambling addiction, food addiction, and Internet addiction). Similar to substance use disorders, these "behavioral addictions" consist of potentially maladaptive behavioral patterns (e.g., preoccupation with – and loss of control over – the behavior: Demetrovics & Griffths, 2012; Sussman, 2017). Evidence from genetic, neuroimaging, and biochemical studies indicates that there is considerable overlap in the neurobiological mechanisms underlying both drug-related and non-drug-related addictive behaviors (Grant, Brewer, & Potenza, 2006). Interestingly, preclinical and epidemiological studies suggest that a history of past engagement in one addictive behavior may contribute to greater risk of engagement in another addictive behavior in the future. For instance, rats exhibit amphetamine-induced sensitization (i.e., an exaggerated behavioral and neurobiological response thought to be one mechanism underlying addiction: Robinson & Berridge, 1993), following earlier exposure to "gambling-like" schedules of rewarding stimuli or excessive sugar consumption (Avena & Hoebel, 2003b; Zack, Featherstone,Mathewson, & Fletcher, 2014). Conversely, earlier exposure to amphetamine increases later sugar intake and sexual behavior (Avena & Hoebel, 2003a; Fiorino & Phillips, 1999). Further, in adolescent humans both alcohol and cigarette use may precede Internet addiction (Lee, Han, Kim, & Renshaw, 2013).

Another possible risk factor for drug use and abuse is trait impulsivity. Impulsivity is a broad, multifaceted construct that is often described in two ways: (1) impulsive action, defined as a lack of behavioral inhibition without regard to potential negative consequences; and (2) impulsive choice, defined as a failure of self-control or inability to delay gratification (Grant & Chamberlain, 2014; Perry & Carroll, 2008; Weafer, Mitchell, & de Wit, 2014). Impulsivity is quite common (approximately 17% of the U.S. population) especially in younger individuals (Chamorro et al., 2012), and several lines of evidence indicate a strong relationship between impulsivity and drug use. College undergraduates with greater impulsivity self-report initiation of cigarette, alcohol, and marijuana use at a younger age than their less impulsive peers (Kollins, 2003). Additionally, greater impulsivity in adolescence predicts future increases in alcohol consumption (Fernie et al., 2013), and impulsive adolescent tobacco smokers are less likely to successfully maintain smoking abstinence following a quit attempt (Krishnan-Sarin et al., 2007).

Trait impulsivity in adolescents and adults is also associated with several behavioral addictions, including gambling (Chambers & Potenza, 2003; F. Vitaro, Arseneault, & Tremblay, 1999), Internet use (Mottram & Fleming, 2009), and overeating (Davis et al., 2011; Fischer & Smith, 2008). Recently, Sussman et al. (2014) reported that the prevalence of behavioral addictions in a population of recent graduates of California alternative high schools (which are comprised primarily of students who have one or more behavioral/psychological problems, including possible trait impulsivity) is relatively high (i.e., 62% endorsed at least one current behavioral addiction). Further, Vitaro, Ferland, Jacques, and Ladouceur (1998) reported that adolescents who had co-occurring gambling and substance use disorders were more impulsive than those who had either a gambling or substance use disorder alone, suggesting that there is likely a cumulative-type relationship between impulsivity and several co-occurring expressions of drug- and non-drug-related behavioral addictions.

Here, we further examine the potential relationship between two self-reported risk factors (impulsivity, the presence of one or more behavioral addictions) and tobacco, alcohol and marijuana use – or susceptibility to use these drugs in the future among nonusers – in an adolescent population. We predicted that individuals with high trait impulsivity would be more likely to endorse engagement in one or more non-drug-related behavioral addictions compared to their low-impulsivity counterparts. We further hypothesized that individuals with either risk factor would be more likely to use–or would be more susceptible to use–tobacco, alcohol, and/or marijuana compared to individuals with neither risk factor, and that individuals with both risk factors would be at the greatest risk for use.

2. Method

2.1. Participants and procedure

Approximately 40 public high schools in the Los Angeles metropolitan area were identified as potential data collection sites for a larger study on emotion, addiction, and health. These schools were chosen because of their diverse economic and ethnic demographic characteristics. In total, ten schools agreed to participate (school characteristics have been published previously: Leventhal et al., 2015). For each school all ninth graders who were not

enrolled in an English as a second language or special education program (e.g., severe learning/developmental disorder) were invited to participate (N = 4100). The percentage of students eligible for free lunch within each school (i.e., parents' income is at or below 185% of the national poverty level) on average across the ten schools was 31.1% (SD = 19.7, range: 8.0%–68.2%). Study assent and consent rates (N = 3396 [82.3%]) and survey completion rates among contenting students (N = 3383 [99.6%]) were comparable to or exceed studies of public high school students in the region (Sussman, Dent, & Stacy, 2002; Unger, Ritt-Olson, Soto, & Baezconde-Garbanati, 2009). In order to test our hypotheses relating to high trait impulsivity, we used an extreme groups approach and included only individuals who were scored as endorsing either high or low trait impulsivity (see below for description of measures). Thus for the current analysis our final sample was 1612 participants (Mean ± SD age = 14.07 ± 0.40 years). Data collectors administered the paper-and-pencil surveys with the measures described below in compulsory classes and emphasized the confidentiality of student responses.

2.2. Measures

2.2.1. Trait impulsivity—Participants completed a 5-item questionnaire that consisted of a subset of binary true/false items from the Temperament and Character Inventory–Impulsivity Scale (Cloninger, 1994). The questions were: "I often do things based on how I feel at the moment without thinking about how they were done in the past"; "I like to think about things for a long time before I make a decision [reverse-coded]"; "I usually think about all the facts in detail before I make a decision [reverse-coded]"; "I often follow my instincts, hunches, or intuition without thinking through all the details"; "I like to make quick decisions so I can get on with what has to be done". Participants who endorsed 4 or more items were considered to have high trait impulsivity (N = 783; 23.1% of the original sample) and those who endorsed 1 or fewer items were considered to have low trait impulsivity (N = 829; 24.5% of the original sample). Analysis of reliability of the five dichotomous items using polychoric correlations revealed an alpha coefficient of 0.83 (Gadermann, Guhn, & Zumbo, 2012).

2.2.2. Lifetime behavioral addictions—This 12-item index assesses engagement in a range of potentially addictive behaviors (Sussman, Lisha, & Griffiths, 2011). The header for the measure read: "Sometimes people have an addiction to a certain drug or other object or activity. An addiction occurs when people experience the following: they do something over and over again to try to feel good, for excitement, or to stop feeling bad; they can't stop doing this thing, even if they wanted to; bad things happen to them or to people they care about because of what they are doing". Below the header participants were asked to respond yes or no to whether they were "ever addicted to the following things": "cigarette smoking", "alcohol drinking", "other drugs", "eating", "gambling", "Internet", "online or offine video games", "shopping", "love", "sex", "exercise", "work". For the purpose of this analysis, we removed the drug-related items, leaving 9 non-drug-related behavioral addictions. The primary predictor was categorized as either the absence of a non-drug-related behavioral addiction (coded '0'), the presence of one behavioral addiction (coded '1'), the presence of two behavioral addictions (coded '2'), or the presence of three or more behavioral addictions (coded '3'). Previous longitudinal research examining addictive behaviors in adults indicates

that this measure has good test-retest reliability, as individuals tended to endorse the same lifetime prevalence addictive behaviors across two time points one year apart (Sussman, Pokhrel, Sun, Rohrbach, & Spruijt-Metz, 2015).

2.2.3. Past 6-month drug use—Participants completed questionnaires based on the Youth Risk Behavior Surveillance (YBRS: Eaton et al., 2010) and Monitoring the Future (MTF: Johnston, O'Malley, Bachman, & Schulenberg, 2010) assessing past 6-month use of three drugs: tobacco, alcohol, marijuana. Previous research indicates that these self-report adolescent drug use questionnaires have good criterion validity as they have predictable associations with self-reported attitudes about drug use as well as other indicators of drug use, such as positive urinalysis for drug use and official reports from police and treatment agencies (Bachman, Johnston, O'Malley, & Schulenberg, 2011). The questionnaire included 8 items for tobacco-related products ("a few puffss of a cigarette", "a whole cigarette", "electronic cigarettes", "smokeless tobacco", "big cigars", "little cigars or cigarillos", "hookah water pipe", and "other forms of tobacco"), one item for alcohol ("one full drink of alcohol"), and two items for marijuana ("blunts" and "marijuana"). Participants responded either yes or no for each item. For each of the three drugs, a binary outcome was created: use (endorsement of at least one product, coded '1'); and no use (lack of endorsement for any item, coded '0'). Additionally, outcomes were created for any drug use (binary endorsement of either tobacco, alcohol or marijuana) and number of drugs used (calculated as the sum of binary endorsements of tobacco, alcohol and marijuana; range = 0–3).

2.2.4. Susceptibility to future drug use in non-drug users—Based on prior research (Gibbons, Gerrard, Blanton, & Russell, 1998;Pierce, Distefan, Kaplan, & Gilpin, 2005), susceptibility to use cigarettes, alcohol, and marijuana in the future was measured with three items: "Would you be willing to try [cigarettes, alcohol, marijuana] if one of your best friends offered it to you?" (Willingness), "Do you think you would [smoke cigarettes, drink alcohol, use marijuana] in the next 6 months" (Intention), and "Have you ever been curious about using [cigarettes, alcohol, marijuana]?" (Curiosity). For each question, the response options were: "Definitely Not", "Probably Not", "Probably Yes", and "Definitely Yes". Based on previous research, participants were dichotomized as either susceptible or not. That is, for each of the three drugs, participants who responded "Definitely Not" to all three susceptibility questions were classified as not susceptible (coded '0'). All other participants were respondents were classified as susceptible (coded '1': Pierce et al., 2005). This measure has been shown to have good predictive validity, as it is associated with future smoking behavior in adolescents (Strong et al., 2015). For this analysis, only participants who reported never using any drug in their lifetime were included ($N = 999$).

2.3. Statistical analyses

We first placed individuals into one of eight Risk Groups based on each individual's trait impulsivity (low, high) and the number of behavioral addictions endorsed (zero, one, two, three or more). Table 1 provides the sample size for each group. We then conducted a chi-square test to examine the potential association between trait impulsivity and the number of lifetime behavioral addictions.

To examine the relationship between impulsivity, behavioral addictions, and past 6-month drug use, we used a generalized linear mixed models (GLMM: using GENLINMIXED in SPSS Version 22) application of logistic regression (using binary or multinomial logistic regression depending on the outcome), accounting for data clustering by school, and with Risk Group as a fixed effect. We conducted separate GLMMs for each drug outcome (tobacco, alcohol, marijuana, any drug, number of drugs) and all analyses controlled for gender, ethnicity, and highest parental education. Significant effects of Risk Group were followed by a set of planned contrasts (presented as odds ratios) between the groups. First, the 'No Risk' group (defined as low impulsivity and zero behavioral addictions) was compared to each of the other seven groups. Then, the 'Combined Risk' group (defined as high impulsivity and 3 or more behavioral addictions) was compared to the 'Single Risk–BA'group (defined as low impulsivity and 3 or more behavioral addictions) and the 'Single Risk–Impulsivity' group (defined as high impulsivity and zero behavioral addictions). Finally, the Single Risk–BA group was compared to the Single Risk–Impulsivity group.

To examine the relationship between impulsivity, behavioral addictions, and susceptibility to future drug use, we used GLMM models similar to those described above. However, for these analyses we restricted the sample to only those participants who reported never trying tobacco, alcohol, or marijuana in their lifetime. For all analyses and contrasts, p values were considered statistically significant at <0.05.

3. Results

3.1. Behavioral addictions and participant demographics

In the entire sample (N = 1612), participants endorsed the full range of behavioral addictions, with 860 participants endorsing more than one. Overall, "Internet" had the highest lifetime prevalence(52.2% of participants endorsed) and "gambling" had the lowest(3.3% of participants endorsed). Of the remaining addictive behaviors, 20.8% endorsed "eating", 31.1% endorsed "online or offine video games", 25.8% endorsed "shopping", 22.1% endorsed "love", 7.7% endorsed "sex", 24.3% endorsed "exercise", and 5.3% endorsed "work".

Table 1 shows the sample demographics by trait impulsivity group: low impulsivity (N = 829) versus high impulsivity (N = 783). These groups did not differ by gender (χ^2 = 2.4; p = 0.12) or ethnicity (χ^2 = 8.8; p = 0.12). However, there was a significant relationship between trait impulsivity and highest parental education (χ^2 = 16.4;p < 0.001); participants in the low impulsivity group reported a higher proportion of "college grad and above" compared to their high impulsivity counterparts.

3.2. Relationship between impulsivity and behavioral addictions

There was a significant association between trait impulsivity and the number of self-reported behavioral addictions (χ^2[2] = 26.2;p < 0.001). Examination of the frequencies in Table 1 show that individuals with high impulsivity were more likely to endorse three or more behavioral addictions compared to individuals with low impulsivity.

3.3. Examination of the relationship between impulsivity, behavioral addictions, and past 6-month drug use

There were significant main effects of Risk Group on all five measures of current drug use: any drug [$F(7,1592) = 14.6$; $p < 0.001$], tobacco [$F(7,1591) = 12.3$; $p < 0.001$], alcohol [$F(7,1539) = 8.5$; $p < 0.001$], and marijuana [$F(7,1579) = 6.7$; $p < 0.001$], as well as the number of drugs used [$F(7,1587) = 213.6$; $p < 0.001$].

Table 2 shows that either the presence of behavioral addictions or impulsivity alone significantly increased the likelihood for drug use across all five outcomes. Furthermore, the combination of both risk factors produced the highest likelihood for drug use. For example, compared to those in the No Risk group (i.e., those with low impulsivity and no behavioral addictions), participants with low impulsivity and two behavioral addictions were significantly more likely to use a tobacco product (OR[95%CI] = 2.50[1.11, 5.62]), and those with three or more behavioral addictions were at even greater risk (OR[95%CI] = 3.36[1.64, 6.85]). Further, participants in the high impulsivity group with no behavioral addictions were significantly more likely to use a tobacco product (OR[95%CI] = 3.72[1.77, 7.84]), and the impulsivity-related risk for tobacco use increased “dose-dependently” with the number of behavioral addictions (one behavioral addiction: OR [95%CI] = 4.93[2.34, 10.40]; two behavioral addictions: OR[95%CI] = 7.34[3.62, 14.89]; three or more behavioral addictions: OR[95%CI] = 9.89[5.13, 19.04]).

Additionally, participants in the Combined Risk group were significantly more likely to use a tobacco product (OR[95%CI] = 7.96[4.21, 15.02]) compared to both the Single Risk–BA group (OR[95%CI] = 2.95[1.88, 4.63]) and Single Risk–Impulsivity group (OR[95%CI] = 2.66[1.61, 4.39]). There was no significant difference between the Single Risk groups (Single Risk–BA versus Single. Risk–Impulsivity: OR[95%CI] = 1.11[0.62, 1.98]).

Similar results were found for all other drug use outcomes, including alcohol and marijuana use, any drug use, and number of drugs used (see Table 2), with the one exception that, for marijuana use, the high impulsivity with two behavioral addictions group was not significantly different than the No Risk group ($p = 0.056$).

3.4. Examination of the relationship between impulsivity, behavioral addictions, and susceptibility to drug use

Among participants who had never used a drug ($N = 999$), we found significant main effects of Risk Group on measures of susceptibility to use any drug [$F(7988) = 8.6$; $p < 0.001$], tobacco [$F(7987) = 4.3$; $p < 0.001$], alcohol [$F(7987) = 8.0$; $p < 0.001$], and marijuana [$F(7986) = 4.2$; $p < 0.001$], as well as susceptibility for a greater number of drugs used [$F(7985) = 14.5$; $p < 0.001$]. Similar to the 6-month drug use results described above, for the most part the likelihood of greater susceptibility to future drug use systematically altered as a function of the number of risk factors (see Table 3), with one notable exception. That is, there were no significant differences between the No Risk group and those groups with low impulsivity and any number of behavioral addictions for susceptibility for tobacco use (ORs = 0.97–1.42; $ps = 0.39$–0.95).

4. Discussion

The current study examined the relationship between adolescent drug use and two potential risk factors: impulsivity and a history of non-drug-related behavioral addictions. There was a significant positive association between high trait impulsivity and the number of lifetime behavioral addictions (of 9; e.g., Internet, eating, shopping). Additionally, we found that individuals who endorsed either one of the risk factors were more likely to have used either tobacco, alcohol, or marijuana in the past 6 months, compared to their counterparts who had neither risk factor. Further, a greater number of behavioral addictions appeared to increase the risk for drug use, and individuals who endorsed both impulsivity and three or more behavioral addictions were at the greatest risk for tobacco, alcohol, or marijuana use. For the most part, the same relationship held true among those who had never tried a drug in their lifetime; those with the combined risk factors of impulsivity and three or more behavioral addictions were more likely to be susceptible to future use of tobacco, alcohol, and/or marijuana. Overall, these data are consistent with previous studies showing that impulsivity and behavioral addictions are positively related with each other (Chambers & Potenza, 2003; Davis et al., 2011; Fischer & Smith, 2008; Mottram & Fleming, 2009; Vitaro et al., 1999) and with drug use (Frank Vitaro et al., 1998). These data also extend previous results by demonstrating that a history of behavioral addictions in and of itself is a risk factor for drug use in adolescents and that trait impulsivity may further exacerbate this risk.

One possible explanation for the current findings is that high trait impulsivity may increase the risk for non-drug-related behavioral addictions. Then this history of engagement in non-drug-related addictive behaviors directly increases risk for drug use perhaps due to a generalized “cross-sensitization” of responses to rewarding stimuli (Robinson & Berridge, 1993). (However the converse set of relations, drug use impacting non-drug related addictive behaviors, also may occur). Under this conception, one plausible hypothesis would be that individuals with a greater level of engagement in non-drug-related addictive behaviors might later find initial drug exposure more rewarding thus potentially increasing the likelihood of continued drug use. The current results support this possibility, as the likelihood of tobacco, alcohol, and marijuana use appeared to “dose-dependently”increase with the number of self-reported lifetime behavioral addictions. Of course this potential explanation is speculative because the current measure of the number of behavioral addictions may not correspond to the actual level of engagement with each behavior over time. Additionally, the current study is cross-sectional, thus we cannot determine whether earlier engagement in behavioral addictions is casually related to future drug use. Future studies should investigate the temporal relationship between trait impulsivity, level of engagement with behavioral addictions, and drug use.

Another possible explanation for the current findings is that a history of behavioral addictions is not a causal factor for drug use per se, but merely a behavioral marker for at-risk adolescents in general. That is, there are likely several other factors–such as trait impulsivity–that may equally increase risk for both drug use (Fernie et al., 2013;Kollins, 2003; Krishnan-Sarin et al., 2007) and non-drug-related behavioral addictions (Chambers & Potenza, 2003; Davis et al., 2011; Fischer & Smith, 2008; Mottram & Fleming, 2009; F. Vitaro et al., 1999). Interestingly, the current findings in the subset of non-drug users that

there was no significant difference between the No Risk group and those groups with low impulsivity and any number of behavioral addictions on susceptibility for future cigarette use suggests that impulsivity alone may explain a larger proportion of the risk for future drug use than a history of behavioral addictions alone. Ultimately, it is possible that impulsive adolescents may first exhibit non-drug-related behavioral addictions simply because many rewards (such as food and the Internet use) are more readily available than drugs (such as tobacco, alcohol, and marijuana). It is also important to note that one potential confound for the current findings is level of parental education (a measure of socioeconomic status). The impulsivity measure used here was positively related to parental education and while we controlled for this potential confound in all analyses, it remains unclear whether the drug use risk for impulsive individuals is due to this specific trait personality measure per se or if impulsivity is a simply a marker of a complex set of other environmental risk factors. Future longitudinal studies might investigate the impact of both trait impulsivity and a larger set of risk – and protective – factors on initiation of both drug- and non-drug-related behavioral addictions, and how differential initiation of specific behavioral addictions is influenced by real and perceived access to the relevant rewards.

These results should be considered in the context of at least two additional limitations. First, it is important to note that we did not explicitly assess the range of potential psychosocial disruptions that are usually associated with addictive disorders, and thus it is not clear that participants' self-report of behavioral addiction would be clinically relevant. While these data are largely consistent with previous studies showing that addictive behaviors are quite common in the general population (Sussman et al., 2014; Sussman et al., 2015), future studies should investigate whether clinical-level disruptions caused by engagement in various addictive behaviors are related to current and/or future drug use. Second, it is not clear whether the results from a population of Los Angeles students would generalize to other populations. For the most part, adolescents in California live in a regulatory environment that has substantially reduced tobacco use (via public health campaigns and local smoking ordinances), while normalizing marijuana use (via the passage of medical marijuana use laws in 1996, and recreational marijuana use laws in 2016). It is likely that this local environment plays a role in the risk for initiation of these drugs. Future studies might examine impulsivity, behavioral addictions, and drug use in a more geographically diverse sample.

5. Conclusion

We found evidence that impulsivity was related to behavioral addictions in adolescents, and that the combination of these two factors increased risk for drug use. That is, adolescent high school students who endorsed high trait impulsivity and had a history of behavioral addictions were more likely than their peers to have used tobacco, alcohol, and/or marijuana in the past 6 months. Further, among individuals who had never tried a drug, those who endorsed both risk factors were more susceptible to drug use in the future. These findings suggest that it may be fruitful to design a preventive strategy that identifies impulsive adolescents who engage in addictive behaviors.

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Table 1:

Demographic characteristics and addictive behaviors endorsement by trait impulsivity group.

	Trait impulsivity group		χ^2	*P*
	Low impulsivity (*N* = 829)	**High impulsivity (*N* = 783)**		
Gender, n (%)			2.4	0.12
Female	486 (58.6%)	429 (54.8%)		
Male	343 (41.4%)	354 (45.2%)		
Ethnicity, n (%)			8.8	0.12
Asian	175 (21.6%)	131 (16.8%)		
Black	44 (5.4%)	37 (4.8%)		
Hispanic	330 (40.6%)	359 (46.1%)		
Multiracial	68 (8.4%)	55 (7.1%)		
White	144 (17.7%)	144 (18.5%)		
Other	51 (6.3%)	52 (6.7%)		
Parental education, n (%)			16.4	< 0.001
High school grad and below	182 (25.1%)	209 (29.5%)		
Some college	125 (17.3%)	165 (23.3%)		
College grad and above	417 (57.6%)	334 (47.2%)		
Behavioral addictions, n (%)			26.2	< 0.001
None endorsed	268 (32.3%)	176 (22.5%)		
One endorsed	165 (19.9%)	143 (18.3%)		
Two endorsed	156 (18.8%)	164 (20.9%)		
Three or more endorsed	240 (29.0%)	300 (38.3%)		

Note: Total *Ns* vary for each analysis due to different patterns of missing data or reporting “unknown” as a response: Gender (*N* = 1612); Ethnicity (*N* = 1590); Parental Education (*N* = 1432); Behavioral Addictions (*N* = 1612).

Table 2:

Odds ratios (95% CI) of using tobacco, alcohol, or marijuana in the past 6 months as a function of Risk Group.

	Any drug	# of drugs	Single drug		
			Tobacco	Alcohol	Marijuana
No Risk (vs. all other groups)					
Lo Imp: 0 BA	Ref	Ref	Ref	Ref	Ref
Lo IMP: 1 BA	1.45 (0.72, 2.93)	1.38 (0.84, 2.26)	1.41 (0.57, 3.48)	1.91 (0.75, 4.84)	1.33 (0.35, 5.05)
Lo IMP: 2 BA	2.53 (1.33, 4.78) *	2.86 (2.09, 3.91) **	2.50 (1.11, 5.62) *	3.12 (1.32, 7.37) *	3.19 (1.04, 9.77) *
Lo IMP: 3+ BA	3.20 (1.82, 5.62) **	3.34 (2.50, 4.44) **	3.36 (1.64, 6.85) *	4.13 (1.91, 8.92) **	3.46 (1.25, 9.58) *
Hi IMP: 0 BA	2.77 (1.50, 5.13) *	2.59 (1.85, 3.63) **	3.72 (1.77, 7.84) *	3.26 (1.41, 7.54) *	3.78 (1.28, 11.13) *
Hi IMP: 1 BA	5.17 (2.85, 9.39) **	4.13 (2.51, 6.81) **	4.93 (2.34, 10.4) **	5.81 (2.60, 12.95) **	6.60 (2.35, 18.51) **
Hi IMP: 2 BA	5.61 (3.15, 10.02) **	4.46 (2.85, 6.99) **	7.34 (3.62, 14.89) **	6.10 (2.78, 13.38) **	2.97 (0.97, 9.07)
Hi IMP: 3+ BA	8.52 (5.04, 14.41) **	8.07 (5.59, 11.65) **	9.89 (5.13, 19.04) **	9.40 (4.57, 19.34) **	10.13 (3.95, 25.95) **
Single Risk-BA (vs. single risk-impulsivity and combined risk)					
Lo IMP: 3+ BA	Ref	Ref	Ref	Ref	Ref
Hi IMP: 0 BA	0.87 (0.52, 1.44)	0.78 (0.63, 0.95) *	1.11 (0.62, 1.98)	0.79 (0.42, 1.49)	1.09 (0.49, 2.43)
Hi IMP: 3+ BA	2.67 (1.80, 3.95) **	2.42 (1.86, 3.15) **	2.95 (1.88, 4.63) **	2.27 (1.42, 3.63) *	2.93 (1.63, 5.28) **
Single Risk-impulsivity (vs. combined risk)					
Hi IMP: 0 BA	Ref	Ref	Ref	Ref	Ref
Hi IMP: 3+ BA	3.07 (1.94, 4.88) **	3.12 (2.57, 3.79) **	2.66 (1.61, 4.39) **	2.89 (1.62, 5.14) **	2.68 (1.35, 5.35) *

Note: Lo IMP = low impulsivity; Hi IMP = high impulsivity; BA = behavioral addictions.

No Risk group = Lo Imp: 0 BA; Single Risk–BA group = Lo IMP: 3+ BA; Single Risk–impulsivity group = Hi IMP: 0 BA; Combined Risk group = Hi IMP: 3+ BA.

Groups sizes = Lo IMP: 0 BA (N = 268); Lo IMP: 1 BA (N = 165); Lo IMP: 2 BA (N = 156); Lo IMP: 3+ BA (N = 240); Hi IMP: 0 BA (N = 176); Hi IMP: 1 BA (N = 143); Hi IMP: 2 BA (N = 164); Hi IMP: 3+ BA (N = 300).

* $p < 0.05$.

** $p < 0.001$.

Table 3:

Odds ratios (95% CI) of endorsing susceptibility to use cigarettes, alcohol, or marijuana in the future as a function of Risk Group.

Number of behavioral addictions	Any drug	# of drugs	Single drug		
			Tobacco	Alcohol	Marijuana
No Risk (vs. all other groups)					
Lo Imp: 0 BA	Ref	Ref	Ref	Ref	Ref
Lo IMP: 1 BA	1.62 (1.03, 2.56) *	1.59 (0.92, 2.73)	1.22 (0.52, 2.85)	1.44 (0.90, 2.28)	1.97 (0.89, 4.36)
Lo IMP: 2 BA	2.27 (1.39, 3.72) *	2.29 (1.57, 3.33) **	0.97 (0.36, 2.61)	2.27 (1.39, 3.73) *	3.22 (1.47, 7.03) *
Lo IMP: 3+ BA	2.94 (1.90, 4.56) **	2.55 (1.81, 3.61) **	1.42 (0.64, 3.14)	2.60 (1.67, 4.03) **	2.44 (1.15, 5.15) *
Hi IMP: 0 BA	2.53 (1.59, 4.01) **	2.59 (1.63, 4.13) **	2.36 (1.10, 5.06) *	2.25 (1.41, 3.58) *	3.43 (1.64, 7.19) *
Hi IMP: 1 BA	3.58 (2.07, 6.21) **	4.41 (2.35, 8.27) **	5.04 (2.33, 10.87) **	3.52 (2.03, 6.10) **	4.89 (2.20, 10.85) *
Hi IMP: 2 BA	4.01 (2.38, 6.74) **	4.01 (2.54, 6.34) **	2.96 (1.35, 6.48) *	3.46 (2.06, 5.79) **	5.00 (2.35, 10.62) **
Hi IMP: 3+ BA	4.76 (2.90, 7.79) **	4.75 (2.48, 9.09) **	3.37 (1.63, 6.99) *	4.61 (2.82, 7.53) **	5.04 (2.46, 10.33) *
Single Risk-BA (vs. single risk-impulsivity and combined risk)					
Lo IMP: 3+ BA	Ref	Ref	Ref	Ref	Ref
Hi IMP: 0 BA	0.86 (0.53, 1.41)	1.02 (0.59, 1.76)	1.66 (0.76, 3.66)	0.87 (0.53, 1.41)	1.41 (0.71, 2.81)
Hi IMP: 3+ BA	1.62 (0.96, 2.72)	1.86 (1.07, 3.23) *	2.38 (1.12, 5.04) *	1.77 (1.06, 2.97) *	2.07 (1.07, 4.01) *
Single Risk-impulsivity (vs. combined risk)					
Hi IMP: 0 BA	Ref	Ref	Ref	Ref	Ref
Hi IMP: 3+ BA	1.87 (1.10, 3.21) *	1.83 (1.17, 2.87) *	1.43 (0.70, 2.93)	2.05 (1.20, 3.50) *	1.47 (0.77, 2.83)

Note: Lo IMP = low impulsivity; Hi IMP = high impulsivity; BA = behavioral addictions.

No Risk group = Lo Imp: 0 BA; Single Risk–BA group = Lo IMP: 3+ BA; Single Risk–impulsivity group = Hi IMP: 0 BA; Combined Risk group = Hi IMP: 3+ BA.

Groups sizes = Lo IMP: 0 BA (N = 227); Lo IMP: 1 BA (N = 132); Lo IMP: 2 BA (N = 99); Lo IMP: 3+ BA (N = 146); Hi IMP: 0 BA (N = 121); Hi IMP: 1 BA (N = 76); Hi IMP: 2 BA (N = 89); Hi IMP: 3+ BA (N = 109).

* $p < 0.05$.

** $p < 0.001$.