



## Sex differences in the association between impulsivity and driving under the influence of alcohol in young adults: The specific role of sensation seeking

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### ABSTRACT

**Introduction:** There is an outstanding need to identify predictors of driving under the influence of alcohol (DUI) among young adults, particularly women. Impulsivity, or the tendency to act without thinking, is a predictor of DUI, but the specific facets of impulsivity that predict DUI and their interaction with sex differences remain unclear. We aimed to investigate sex differences in the link between impulsivity facets and DUI. Moreover, we sought to replicate previous findings regarding sex differences on impulsivity, and associations between impulsivity facets and DUI.

**Method:** A total of 506 university students participated in the study (males,  $n = 128$ ; females,  $n = 378$ ). Participants completed measures of impulsivity (UPPS-P short version), alcohol use (AUDIT-C), frequency of DUI episodes and related perception of risk. The UPPS-P assesses five facets of impulsivity: sensation seeking, (lack of) premeditation and perseverance and positive and negative urgency.

**Results:** Men showed higher sensation seeking and lack of perseverance, alcohol use and DUI frequency and lower risk perception than women. DUI frequency was negatively associated with perception of risk and positively associated with alcohol use and the five impulsivity facets. After controlling for alcohol use and risk perception, only lack of premeditation was associated with DUI frequency in the whole sample. Sensation seeking was positively associated with DUI frequency only in women.

**Discussion:** The link between lack of premeditation and DUI suggest that pre-drinking planning strategies can contribute to prevent risky driving. In women, specific links between sensation seeking and DUI suggest the need for personality-tailored prevention strategies.

### 1. Introduction

In 2016, 25,670 people were killed in the European Union as a consequence of road collisions (European Transport Safety Council, 2017). Driving under the influence of alcohol (DUI) is linked to around 25% of all road deaths in Europe (European Commission, 2015), with an estimation of at least 5120 deaths that could have been prevented in 2016 if all drivers had been sober (European Transport Safety Council, 2018). Young adults are particularly at risk, since they are more likely

to use alcohol and drive (Commission of the European Communities, 2012; European Commission, 2014) and more likely to suffer road accidents related to alcohol (World Health Organization, 2009, 2013). Thus, there is an outstanding need to identify predictors of DUI among young adults (McMurran et al., 2011). Moreover, although the prevalence of DUI is generally higher in young males than in females (Chou et al., 2006; Brown et al., 2015; Delker et al., 2016), the trends show steady increases for women in the last three decades (e.g., Armstrong et al., 2014; Tsai et al., 2008; Kelley-Baker and Romano, 2010; Romano

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et al., 2008). However, there is little research on sex differences in individual characteristics related to DUI (e.g., McMurrin, et al., 2011; Watling, and Armstrong, 2017).

Previous studies in young adults (males and females) have pinpointed three main risk factors for traffic accidents related to alcohol: (i) greater alcohol use severity (Caamaño-Isorna et al., 2017), (ii) low risk perception of DUI (e.g., Cohn et al., 1995), and (iii) specific personality traits (Machin and Sankey, 2008), especially impulsivity – the tendency to act without planning – (e.g., Jonah, 1997; Moan et al., 2013). These factors are independent predictors of DUI but can also interact in important ways. For instance, multiple studies have shown that impulsive people tend to drink more heavily (Dick et al., 2010), have lower perception of potential negative consequences of DUI (Ryb et al., 2006), and drive more frequently after drinking than non-impulsive people (e.g., Jonah, 1997; Treloar et al., 2012).

Very few studies have examined predictors of DUI as a function of sex (e.g., Brown, et al., 2015). This oversight is relevant because sex differences preclude from generalizing the results observed in males to females. For instance, males usually drink more heavily (Courtney and Polich, 2009), and perceive lower risk and more acceptance of driving after drinking (MacLeod et al., 2015; Politis et al., 2013); they also show less concern about perceived risk compared to females (Cordellieri et al., 2016). Moreover, recent meta-analyses show that males and females differ on several facets of impulsivity. Males show higher levels of sensation seeking – the tendency to engage in intense, novel, or potentially dangerous (arousing) activities – (see Cross et al., 2011), whereas females are less tolerant to delayed rewards (Weafer and de Wit, 2014).

Different perspectives have been used to define the construct of impulsivity, describing it as the inability to inhibit a preponderant response, the preference for immediate small rewards rather than larger delayed rewards, or the tendency towards unplanned actions (Stevens et al., 2014). However, the multidimensional nature of impulsivity is currently well-accepted (Sharma et al., 2014), and the UPPS-P model is one of the most influential theories of impulsivity (Cyders, Smith, Spillane, Fischer, Annus, & Peterson, 2007); especially in addiction and risk decision-making research (e.g., Billieux, et al., 2010; Canale et al., 2017). This model stems from a combination of the UPPS Impulsive Behavior Scale (Whiteside and Lynam, 2003) and the Positive Urgency Measure (PUM; Cyders et al., 2007), and posits five different facets of impulsivity: sensation seeking, lack of premeditation (poor consideration of potential consequences), lack of perseverance (difficulty to stay focused on long, complex tasks), and positive and negative urgency (triggering impulsive responses under negative and positive moods, respectively) (Cyders and Smith, 2008). To our knowledge, three studies have investigated the association between UPPS facets and DUI (Bachoo et al., 2013; Luk et al., 2017; Treloar et al., 2012), all of them focusing on young adults and/or college students [Bachoo et al., (2013) including post-graduate university students from 18 to 52 years of age]. Findings suggest that four of the five dimensions (all but positive urgency) are directly or indirectly related to DUI. The most consistent finding is a direct association between negative urgency and DUI. However, results are disparate for sensation seeking, lack of premeditation, and lack of perseverance. Moreover, two of the three studies did not include measures of positive urgency, which can be specifically important in young adults as they may often drink during partying (García-Delgado et al., 2004). Furthermore, none of the studies specifically examined sex differences, despite evidence suggests that males and females can have different drivers of DUI.

The main aim of the present study was to investigate sex differences in the link between UPPS-P impulsivity facets and DUI among young adults. Since, to the best of our knowledge, this is the first study addressing this research question, we will follow an exploratory analysis approach and our hypotheses thereby remain open. Complementary, we also aimed to replicate previous findings regarding sex differences on impulsivity, and on the associations between the UPPS-P impulsivity

facets and DUI in the whole sample (both males and females). For these secondary aims, based on the previous literature, we hypothesized that impulsivity facets would be positively associated with DUI frequency (Treloar et al., 2012; Bachoo et al., 2013), and that males will show higher positive urgency, sensation seeking, and lack of premeditation than females (Cyders, 2013).

## 2. Method

### 2.1. Participants and procedure

We recruited a convenience sample of 1008 undergraduate students from a variety of degree courses at the University of Granada (Spain) (Education Sciences, Business and Economic Sciences, Health Sciences, Law, Optometry, Philosophy and Literature, Psychology, Sociology, and Political Sciences). Participants were informed about the aims of the study, signed an informed consent form, and completed a battery of self-report questionnaires in groups (between 15 and 50 students per group). This study was part of a larger trial assessing the efficacy of brief psychological interventions for alcohol use and risky behaviors in college students. Here we report the results of the baseline assessments, and the outcomes of the trial will be published elsewhere.

The inclusion criteria for participants were defined as follows: (i) ages 18–30 (as in several previous studies in traffic research [e.g., Luk et al., 2017] and in accordance with the upper end of the interval of young adulthood [Durbin et al., 2016]), (ii) having a driving license, (iii) having driven at least once per month in the last year, and (iv) completing the whole assessment package. Twenty-one participants were older than 30 years, 374 did not have a driving license, 34 did not drive often enough, and 73 left socio-demographic information, control and/or outcome variables without answer. Thus, 506 participants were finally included in the study (males,  $n = 128$ ; females,  $n = 378$ ). Sensitivity analysis with G\*power (<http://www.gpower.hhu.de>) indicated that this sample size was sufficient to detect an effect size of  $OR = 1.43$  in a Poisson regression for one-unit change in the predictor variable (with  $\alpha = .05$ , power = .80, assuming a low base event rate of 0.10 and  $R^2 = .10$  for other variables), which we considered sensitive enough given our exploratory purposes. The Human Ethics Committee of the University of Granada approved the study protocol.

### 2.2. Measures

#### 2.2.1. Impulsivity

*UPPS-P – Short version* (Cándido et al., 2012). This scale contains 4 items for each of five dimensions, representing the five impulsivity facets: *Negative urgency*, *Positive urgency*, *Lack of premeditation*, *Lack of perseverance*, and *Sensation seeking*. Item responses range between 1 (strongly agree) to 4 (strongly disagree). The scale showed good internal reliability and external validity (Pilatti et al., 2015; Verdejo-García et al., 2010). Specifically, the Spanish UPPS-P short version showed adequate internal consistency (Cronbach's alpha between 0.61 and 0.81). Due to a high concordance between scores on both Spanish versions (short and long), the short version is recommended in research studies (Lozano, Díaz-Batanero, Rojas, Pilatti & Fernández-Calderón, 2018).

#### 2.2.2. Outcome variable

*DUI frequency*. The DUI outcome measure assessed the monthly frequency of driving after drinking any amount of alcohol: “How many times per month on average do you drive after having consumed alcohol?”, henceforth DUI frequency.

#### 2.2.3. Control variables

*AUDIT Alcohol Consumption Screening* (AUDIT-C; García-Carretero et al., 2016). This brief scale assesses alcohol use severity. It consists of 3 items assessing frequency of alcohol use, amount of alcohol consumed

on each occasion, and frequency of heavy drinking episodes (defined as 6 or more drinks in a single episode), during the past year. Each item is scored on a scale ranging from 0 to 4 points, so that the total score ranges between 0 and 12. This test classifies individuals in the following risk groups: scores between 1–4 indicate low/mild alcohol use, whereas scores between 5–8 and 9–12 points signal moderate and severe alcohol use, respectively (Bradley et al., 2016).

Risk perception of DUI. This variable was assessed with the following two questions: “To what extent do you think alcohol consumption affects how well you drive?” and “How likely is it to have an accident after consuming alcohol?”. Both questions were assessed using scales ranging from 0 (alcohol consumption does not negatively affect my driving at all/having an accident after consuming alcohol is very unlikely) to 6 (alcohol consumption strongly worsens my driving/having an accident after consuming alcohol is very likely). A total risk perception score was computed as the sum of answers on both questions so that larger scores characterize higher risk perception. This approach has been used in other studies on similar questions about attitudes towards drinking and driving (Guppy, 1993) and risky driving behavior (Megías et al., 2013).

### 2.3. Statistical analyses

We conducted analyses using the Statistical Package for the Social Sciences (SPSS, version 20). Firstly, we explored the data to detect missing data points and outliers and test statistical assumptions. DUI frequency was analyzed using Poisson regression methods suitable for integer count variables. Residual analysis detected four outliers (DUI frequency  $\geq 20$ , 1 male, 3 females), which were subsequently excluded. Thus, the final dataset comprised 502 participants: 127 males/375 females. The questionnaire measures did not follow normal distributions (Shapiro-Wilk  $< 0.05$ ), and thus we used non-parametric tests. All other relevant assumptions were met (e.g., tolerance statistics and variance inflation factors [VIF]) indicated no significant collinearity between the impulsivity traits). In addition, we examined sex differences in impulsivity and control variables using Mann-Whitney U tests, and univariate associations between these variables and DUI frequency with Poisson regression analysis.

Finally, to address the main goal of the study, we conducted multiple Poisson regression analysis with DUI frequency as a dependent variable, impulsivity traits and sex as independent variables, and severity of alcohol use and risk perception of DUI as control variables. We first explored the main effects of the impulsivity traits and sex; we then added interaction terms between sex and each impulsivity dimension. The purpose of this analysis was to check whether there was an indication that the effect of any of the impulsivity dimensions on DUI frequency depended on sex (indicated by at least one significant interaction term).

## 3. Results

### 3.1. Sex differences and associations between impulsivity facets and DUI frequency

With regard to sex differences, males showed higher sensation seeking and lack of perseverance and alcohol use, and lower risk perception of DUI. Besides, males reported driving under the influence of alcohol more frequently than females (Table 1).

Increased DUI frequency was associated with higher impulsivity (all facets) and alcohol use severity, and lower risk perception of DUI. There was no association between DUI frequency and age (Table 2).

### 3.2. Multiple regression analysis of drivers of DUI frequency

After controlling for alcohol use severity and risk perception, we found a main effect of lack of premeditation on DUI frequency,

indicating that higher lack of premeditation was associated with more DUI episodes (Fig. 1). There were no significant main effects of the other UPPS-P dimensions or sex (Table 3).

We then added the interaction between sex and each impulsivity dimension. There was a significant interaction between sensation seeking and sex on DUI frequency (see Table 4). There were no other significant interactions. Fig. 2 shows that sensation seeking was positively associated with DUI frequency in females but not males, and that females high in sensation seeking engage in DUI as frequently as males.

## 4. Discussion

We aimed to examine sex differences in the association between impulsivity facets and DUI frequency among young adults. We found that higher sensation seeking, an impulsivity facet previously associated with alcohol use and related problems, was uniquely associated with DUI frequency in women. Lack of premeditation was positively associated with DUI frequency in both male and female participants.

The association between sensation seeking and DUI frequency in females resonates with previous findings on sex-specific predictors of other risky behaviors such as alcohol misuse. For instance, Cyders et al., (2009) observed in a sample with 75% females that individuals with higher sensation seeking were more prone to escalate alcohol consumption. Furthermore, Magid and Colder (2007) found that, while sensation seeking did not predict alcohol-related problems in males, in females there were both direct and indirect associations - mediated by motivational factors and alcohol use severity.

Although previous studies have linked sensation seeking and DUI in community samples, the role of sex has received considerably less attention (e.g., Treloar et al., 2012). Moreover, the results of existing studies are mixed (Bıçaksız and Özkan, 2016; Jonah, 1997), making difficult to draw definitive conclusions. For instance, some studies have found no associations between sensation seeking and DUI neither in males nor females (e.g., Brown et al., 2015; Ravert et al., 2009), low associations just in males (e.g., Johnson and White, 1989; Lastovicka et al., 1987) or medium/high associations in both females and males (e.g., Fernandes et al., 2007; Stacy et al., 1991). Methodological differences can contribute to explain these disparate results, since studies have used different samples (e.g., convicted traffic offenders, college students, general population) and assessment methods (e.g., UPPS Scale, Zuckerman's Sensation Seeking Scales-V, the Arnett Inventory of Sensation Seeking).

The most directly comparable studies to ours are Treloar et al. (2012) and Bachoo et al. (2013), which use similar measures (UPPS vs. UPPS-P) and samples (college students). In both studies, there was an association between sensation seeking and DUI after controlling for sex. However, Treloar et al., (2012) found that such association was no longer significant when they factored in other impulsivity dimensions of the UPPS. Pearson et al. (2013) found similar results for other risky driving behaviors beyond DUI. The discrepancies between these studies and our results may be due to the effect of treating sex as a covariate. Therefore, our results illustrate the benefit of examining sex differences to unravel specific pathways between impulsivity and DUI, in line with previous findings in the field of general risk taking (Byrnes et al., 1999).

The link between lack of premeditation and DUI was independent of sex differences and reflects the general role of planning and consideration of consequences in preventing DUI (Martin et al., 2015). Our result is quite similar to that of Bachoo et al. (2013), which found a significant association between lack of premeditation and risky driving after controlling for anger and risk-related attitudes. Also, it is consistent with other studies that associated lack of premeditation –measured with questionnaires different to UPPS-P- with riskier driving (Caspi et al., 1997; Hong and Paunonen, 2009). Nevertheless, Treloar et al. (2012) found that negative urgency (marginally significant in our data) was the only impulsivity facet that contributed to DUI. Also, studies exploring other samples and other risky driving behaviors found

**Table 1**  
Descriptive data and sex differences in age, alcohol use severity, risk perception of DUI, impulsivity, and DUI frequency.

	Total Mean (SD)	Males Mean (SD)	Females Mean (SD)	Test statistics <sup>#</sup>	p	$\eta^2$
Age	20.90 (2.17)	21.00 (2.49)	20.86 (2.05)	23,631.00	.896	0.000
Alcohol use severity *	4.07 (2.16)	4.70 (2.48)	3.86 (2.01)	19,258.00	<b>&lt; .001</b>	0.021
Alcohol use severity range **						
Low/mild	n = 307/61.2%	n = 64/50.4%	n = 243/64.8%			6.96 <sup>^</sup>
Moderate	n = 178/35.5%	n = 52/40.9%	n = 126/33.6%	$\chi^2 = 18.63$	<b>&lt; .001</b>	4.42 <sup>^</sup>
Severe	n = 17 /3.4%	n = 11/8.7%	n = 6/1.6%			
Risk perception of DUI	8.77 (3.07)	8.25 (2.95)	8.95 (3.09)	20,055.00	<b>.007</b>	0.014
Negative urgency	2.46 (0.65)	2.41 (0.68)	2.48 (0.63)	22,314.50	.286	0.003
Positive urgency	2.45 (0.57)	2.53 (0.53)	2.42 (0.59)	21,077.50	.051	0.007
Sensation seeking	2.57 (0.70)	2.80 (0.72)	2.50 (0.68)	17,822.00	<b>&lt; .001</b>	0.036
Lack of premeditation	1.96 (0.56)	1.96 (0.57)	1.97 (0.56)	23,716.50	.945	0.000
Lack of perseverance	1.73 (0.59)	1.88 (0.63)	1.67 (0.56)	19,152.00	<b>.001</b>	0.022
DUI frequency	0.41 (1.26)	0.61 (1.55)	0.34 (1.14)	B = -0.580	<b>&lt; .001</b>	0.20 <sup>^^</sup>

# Mann-Whitney U test, unless otherwise indicated; \* AUDIT-C total score; \*\* AUDIT-C range based on Bradley et al., (2016).

Note: Significant results are indicated in bold. Abbreviations: DUI = Driving under the influence of alcohol. ^^Cohen's d. ^ Odds ratio for being in the severe vs. the other two respective groups for men compared to women.

mixed results. Thus, Luk et al. (2017) found lack of perseverance and sensation seeking were associated with DUI after controlling for covariates in adults with externalizing psychopathology. In contrast, Pearson et al. (2013) found positive urgency was the strongest predictor of risky driving behaviors (not considering DUI). In sum, despite some evidence linking lack of premeditation to DUI, prior studies do not consistently identify which facets of impulsivity predict DUI, nor show clear consistencies with our results. That is, there is a clear and consistent link between impulsivity and DUI among male and female young adults, but no consistent agreement on which impulsivity facets are the most relevant precursors of DUI. Probably, specific impulsivity facets predict specific risky driving behaviors for specific populations.

Further, our data replicates previous findings regarding sex differences on impulsivity, and on the associations between the UPPS-P impulsivity facets and DUI. Thus, as in previous research, our results found higher impulsivity scores in males than females on sensation seeking (Adan et al., 2016; Cross et al., 2011), positive urgency (marginally significant in our study) and lack of perseverance (Cyders, 2013). Further, males showed higher alcohol use severity and DUI frequency (as in Treloar et al., 2012). Moreover, data showed that increased DUI frequency was associated with increases in all impulsivity facets, including the understudied positive urgency, consistent with previous research showing correlations between all impulsivity facets and risky driving (Bachoo et al., 2013; Luk et al., 2017). Thus, impulsivity seems consistently associated with risky driving among young adults.

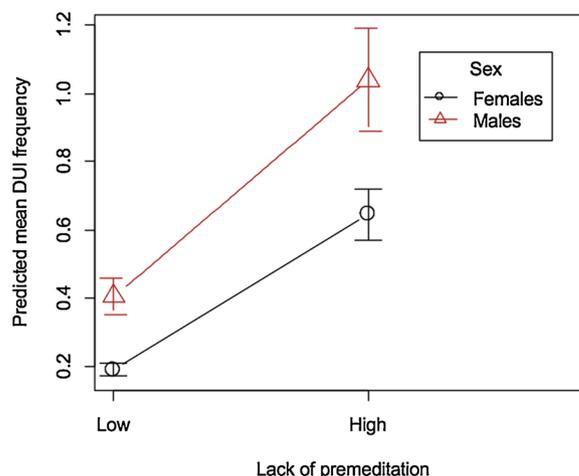
The present findings must be considered in the context of limitations. The cross-sectional nature of the study precludes establishing causal relationships between variables. In addition, the use of a convenience sample of college students limits the representativeness of our sample. On the other hand, while the common definition of young drivers is under 25 years of age, our sample included participants of up to 30 years old. Since the generalization of present findings to less heterogeneous samples in terms of age could be compromised, analyses

**Table 2**  
Matrix of univariate associations between DUI Frequency and age, alcohol use severity, risk perception of DUI, and impulsivity.

		Age	Alcohol use severity	Risk perception of DUI	Negative urgency	Positive urgency	Sensation seeking	LPrem	LPers	Sex
DUI frequency	B	0.048	0.326	-0.249	0.280	0.776	0.617	0.997	0.570	-0.580
	OR	1.049	1.386	0.780	1.323	2.173	1.853	2.709	1.768	0.560
	LLCI/ULCI	0.990/1.112	1.312/ 1.465	0.751/ 0.810	1.069/1.638	1.722/2.741	1.525/2.251	2.178/3.370	1.445/2.162	0.432/0.742
	p	.104	<b>&lt; .001</b>	<b>&lt; .001</b>	<b>.01</b>	<b>&lt; .001</b>	<b>&lt; .001</b>	<b>&lt; 0.001</b>	<b>&lt; 0.001</b>	<b>&lt; 0.001</b>

Note: Significant results of Poisson regression analyses are indicated in bold. Abbreviations: DUI, drive under the influence of alcohol; Lprem, lack of premeditation; Lpers, lack of perseverance. OR, Odd ratios; LLCI/ULCI, Lower level/Upper level 95% confidence intervals.

**Plot of Means**



**Fig. 1.** Effect of lack of premeditation on driving under the influence frequency in the whole sample after controlling for alcohol use severity and risk perception.

were repeated excluding participants older than 24 years. These analyses yielded virtually identical results, thereby reinforcing the main findings of the present study. Finally, it is necessary to take into account that self-report measures can always be affected by memory, demand biases, social desirability and lack of insight.

In spite of this, our study has important strengths. First, our sample comprised a high number of participants with no pathological alcohol use. This help to extrapolate our results to the large majority of young individuals involved in drink-driving episodes. Also, the measures in this study are theory-based and provide a good model to understand risky behavior in this population. As proposed by Cross et al., 2011,

**Table 3**

Results of the Poisson regression analysis with impulsivity and sex as independent variables and controlling for alcohol use severity and risk perception of DUI.

		Negative urgency	Positive urgency	Sensation seeking	LPrem	LPers	Sex
DUI frequency	B	0.209	−0.127	0.128	0.663	0.113	−0.262
	OR	1.233	0.881	1.137	1.940	1.120	0.769
	LLCI/ULCI	0.974/1.561	0.654/1.186	0.916/1.411	1.438/2.618	0.855/1.468	0.571/1.036
	p	.082	.403	.244	< .001	.411	.084

Note: Significant results of Poisson regression analyses are indicated in bold. Abbreviations: DUI, drive under the influence of alcohol; Lprem, lack of premeditation; Lpers, lack of perseverance. OR, Odd ratios; LLCI/ULCI, Lower level/Upper level 95% confidence intervals.

**Table 4**

Results of the Poisson regression analysis with interaction between sex and each impulsivity facet, controlling for alcohol use severity and risk perception of DUI.

		Negative urgency	Positive urgency	Sensation seeking	LPrem	LPers
DUI frequency	B	0.133	0.285	0.717	−0.517	0.205
	OR	1.142	1.329	2.048	0.596	1.227
	LLCI/ULCI	0.714/1.826	0.736/2.401	1.339/3.132	0.326/1.091	0.697/2.162
	p	.580	.346	.001	.094	.478

Note: Significant results of Poisson regression analyses are indicated in bold. Abbreviations: DUI, drive under the influence of alcohol; Lprem, lack of premeditation; Lpers, lack of perseverance. OR, Odd ratios; LLCI/ULCI, Lower level/Upper level 95% confidence intervals.

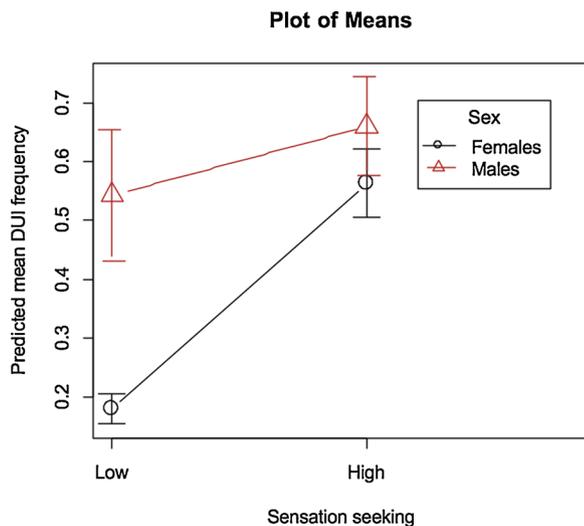


Fig. 2. Interaction between sensation seeking and sex on driving under the influence frequency, after controlling for alcohol use severity and risk perception.

some actions are impulsive and other are risky, but they would be harmless separately. Our study is focused on the relationship of these two variables and their implication in the high incidence of DUI behavior in high impulsive individuals, and could have important clinical implications.

**5. Concluding remarks**

The main findings of this study suggest higher scores on the impulsivity trait of lack of premeditation are related to higher DUI frequency, both in males and females. On the other hand, higher sensation seeking traits associated with this risk behavior are especially problematic in females. These results contribute to a better identification of the variables implicated in DUI frequency among young adults through exploring the role of sex. This is especially relevant, as sex differences may have been partially overshadowed in previous DUI research. Thus, gaining insight in this regard may be informative for tailored preventive interventions.

In fact, community-based programs aimed at preventing DUI in

high-risk individuals may be improved by taking into account our results. On one hand, such programs may include interventions intended for training pre-drinking planning strategies that could be applied to both males and females with a high lack of premeditation. In this regard, it has been suggested that metacognitive interventions are effective at increasing awareness of risk behaviors (e.g. see Noël et al., 2013). On the other hand, the addition of intervention strategies directed at the potential affective bases of their DUI behavior could be effectively applied to females with higher sensation seeking traits. Some approaches that have yielded promising results in reducing risk behaviors in high-risk adolescents comprise several affective components including motivational interviewing and the Socratic discussion of the affective-cognitive underpinnings of the sensation seeking personality (Conrod et al., 2008). Therefore, future studies may address whether this kind of intervention may be effective at reducing DUI frequency, specifically in high sensation-seeking young adult females.

**Competing interests**

The authors have no competing interests to declare.

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