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Differentiating between sensation seeking and impulsivity through their mediated relations with alcohol use and problems

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Abstract

Disinhibition is a strong correlate of alcohol use, yet limited alcohol research has examined the facets of this personality construct. Recent work suggests that sensation seeking and impulsivity show differential relations with alcohol outcomes, indicating unique mechanisms of risks associated with each of these dimensions of disinhibition. The goal of the study was to examine sensation seeking and impulsivity as unique predictors of alcohol use and problems, and to test a broad range of drinking motives as potential mediators of these relations. Self-reported data from college students (*N*=310) were utilized for the study. Results suggested that sensation seeking and impulsivity were associated with alcohol use and problems through different mediational pathways. There was some evidence for gender moderating these pathways.

The findings indicate that alcohol prevention and intervention programs should be tailored to specifically target individuals elevated on impulsivity versus sensation seeking.

Keywords

Alcohol; Sensation seeking; Impulsivity; Drinking motives; College students; Mediation

1. Introduction

Alcohol consumption by college students has remained consistently high over the past 24 years (Johnston, O'Malley, Bachman, & Schulenberg, 2005) and alcohol-related problems continue to be a major concern (Hingson, Heeren, Winter, & Wechsler, 2005). Understanding the etiological pathways leading to problematic college drinking is crucial for the development of effective preventive interventions. A variety of traits related to disinhibited personality have been shown to be associated with alcohol use and problems among college students (e.g., Andrew & Cronin, 1997; Camatta & Nagoshi, 1995; Galen, 1997; Sher, Bartholow, & Wood, 2000; Zuckerman, 1994). Sensation seeking and impulsivity are among the most stable and strong personality correlates of alcohol involvement in this population (e.g., Camatta & Nagoshi, 1995; Earleywine & Finn, 1991; Hutchinson, Patock-Peckham, Cheong, & Nagoshi, 1998; La-Grange, Jones, Erb, & Reyes, 1995; McMillen, Pang, Wells, & Anderson, 1992; Nagoshi, 1999). As discussed below, there are important measurement issues with respect to the assessment of sensation seeking and impulsivity that have largely been ignored in studies of alcohol use. The goal of the present study is to test mediational mechanisms by which sensation seeking and impulsivity are related to alcohol outcomes while using refined measures to reduce the overlap among items that assess these personality traits.

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1.1. Sensation seeking, impulsivity, and alcohol

A number of researchers have proposed that sensation seeking and impulsivity are complex and multidimensional traits (Arnett, 1994; Dickman, 1993; Whiteside & Lynam, 2001; Zuckerman, 1979). Sensation seeking has been defined as a strong need for varied, novel, and stimulated experiences, and willingness to take risks for the sake of such experiences (Zuckerman, 1979). Impulsivity, on the other hand, can be conceptualized as a lack of reflectiveness and planning, rapid decision-making and action, and carelessness (Schalling, 1978). Sensation seeking and impulsivity are related, leading some researchers to combine them into a single construct (e.g., Zuckerman, 1996). Others consider sensation seeking and impulsivity to be separate traits (e.g., Schalling, 1978). To examine whether sensation seeking and impulsivity represent unique constructs or are better conceptualized as facets of a general behavioral disinhibition trait, MacLean and Magid (submitted for publication) performed a confirmatory factor analysis (CFA) of six measures that represented either sensation seeking or impulsivity. A two-factor CFA model fit the data significantly better than a one-factor combined model, suggesting that sensation seeking and impulsivity appear to represent unique traits.

Although distinct from one another, sensation seeking and impulsivity are moderately correlated, which raises some caution when interpreting the relevant alcohol research. First, if one of these traits is included in a model but the other is not, the effects of the non-included variable may be mistakenly attributed to the included trait. Second, most existing measures of sensation seeking and impulsivity reflect the conceptual inconsistencies in the field, such that some measures include items reflecting both traits (even though the measure's label reflects only one; e.g., Eysenck & Eysenck, 1978) and others take a narrower approach and attempt to keep them separate (Schalling, 1978). These conceptual and measurement issues have been evident in the alcohol research that has examined behavioral disinhibition traits as predictors of alcohol involvement. Studies have used measures in which sensation seeking and impulsivity were intentionally combined into one construct (e.g., Read, Wood, Kahler, & Maddock, 2003) or used a measure meant to assess one of the traits but intentionally or inadvertently taps into the other as well (e.g., Nagoshi, 1999; Nagoshi, Wilson, & Rodriquez, 1991). Such studies potentially confound unique relations between sensation seeking, impulsivity, and alcohol involvement. This is supported by the results of a study of college students that included both sensation seeking and impulsivity using relatively pure, narrow measures (MacLean & Magid, submitted for publication). It was found that sensation seeking and impulsivity were differentially related to alcohol use and alcohol problems in college students, such that the former was a stronger predictor of alcohol use and the latter was a stronger predictor of alcohol-related problems. It may be important to distinguish between sensation seeking and impulsivity when considering etiological pathways to alcohol use and problems because different mechanisms may account for risk associated with these personality dimensions.

1.2. Theoretical explanations and mediating pathways

The theoretical underpinnings of the different outcomes related to sensation seeking and impulsivity suggest several possible causal mechanisms. The theory of sensation seeking proposed by Zuckerman (1979, 1994) states that individuals elevated on sensation seeking have a strong need for varied and intense stimulation. Alcohol often increases positive arousal (Connors & Sobell, 1986), and, in accord with Zuckerman's (1979, 1994) theory, individuals high on the trait of sensation seeking may consume alcohol until an optimal level of arousal is reached. Impulsivity has been conceptualized in a number of different ways (see Evenden, 1999). A prominent feature of impulsivity, in contrast to sensation seeking, is failure to inhibit a behavior that is likely to result in negative consequences (Baumeister & Heatherton, 1996; Baumeister & Vohs, 2004; Schalling, 1978). Impulsivity may be a particularly impairing trait

because when faced with a problem, a person high on the trait of impulsivity may be likely to rely on coping methods that can be quickly implemented and provide short-term relief, regardless of the potential long-term negative consequences (Hull & Slone, 2004). With regard to alcohol use, this suggest that individuals high on impulsivity may be inclined to use alcohol to cope with distress, but this is not necessarily expected for individuals high on sensation seeking.

In order to provide insight into the etiological pathways to alcohol-related problems, it is important to consider not only the distal predictors (i.e., personality), but also proximal predictors. Past findings have suggested that drinking motives play an important proximal role in college drinking and development of drinking-related problems (Cooper, 1994; Cooper, Prone, Russel, & Mudar, 1995; Cox and Klinger, 1988; Read et al., 2003). A few studies have examined mediational models, such that disinhibited personality traits predicted drinking motives, which in turn predicted alcohol use and alcohol-related problems. Cooper et al. (1995) found that enhancement motives and alcohol use fully mediated the relationship between sensation seeking and alcohol-related problems in adult and adolescent samples. Cooper et al. (1995), however, did not consider impulsivity as a predictor variable. These results were replicated by Read et al. (2003), who showed that enhancement motives completely mediated the relationship between a combined trait of sensation seeking-impulsivity and alcohol involvement in their cross-sectional sample of college students. It is unclear, however, which aspect of sensation seeking-impulsivity trait accounted for this relationship. Simons, Gaher, Correia, Hansen and Christopher (2005) considered a mediational model with sensation seeking and impulsivity as unique predictors of alcohol use and alcohol problems via enhancement and coping motives. The findings demonstrated that the relation between sensation seeking and alcohol problems was mediated by enhancement motives and alcohol use, whereas the relation between impulsivity and alcohol problems was a direct effect.

However, in line with previous studies, Simons et al. (2005) omitted social and conformity motives from their model. Moreover, even though the mediational model was examined, no formal test of mediation was provided. Finally, none of the above-mentioned studies considered conformity motives, and social motives were included only by Read et al. (2003). This is problematic because enhancement motives are highly correlated with social motives (Cooper, 1994; Read et al., 2003), thus it may be important to include both social and enhancement motives in a model so that their unique effects can be examined. Furthermore, because conformity motives are not expected to be related to sensation seeking or impulsivity, it may be important to include this variable in the model to provide a test of discriminant validity.

Studies that considered mediators of personality risk have not examined gender differences consistently (Simons et al., 2005; Read et al., 2003). However, those studies that did, found gender differences (Cooper et al., 1995; Hussong, Hicks, Levy, & Curran, 2001), suggesting that mechanisms of personality risk may be different for males and females. Given previous findings of gender moderation, it is important to consider gender differences in the context of the proposed mediational pathways in order to detect significant mediated effects that may be present in one group but not the other (Shrout & Bolger, 2002).

1.3. The present study

Considering the conceptual differences between sensation seeking and impulsivity, it is important to evaluate their impact on alcohol use and problems via different drinking motives. The goal of the current study was to extend the findings of MacLean and Magid (submitted for publication) by investigating the mediational pathways from sensation seeking and impulsivity to alcohol use and problems via four drinking motives (Cooper, 1994; see Fig. 1) using measures that have been empirically demonstrated to discriminate between sensation seeking and impulsivity.

Consistent with the theory of sensation seeking as a drive to increase stimulation and positive emotions (Zuckerman, 1979, 1994) and as suggested by the past research (Cooper et al., 1995; Simons et al., 2005), sensation seeking was expected to influence alcohol-related problems via enhancement motives and level of alcohol use. Also in line with the Zuckerman's (1979, 1994) theory, however not tested previously, sensation seeking was expected to impact alcohol-related problems via social motives and level of alcohol use because social interactions can provide positive arousal. Impulsivity was expected to have a direct effect on alcohol-related problems, as poor self-regulation and not considering long term effects of actions when drinking make negative consequences more likely. Also, based on the theory of impulsivity as a failure to regulate one's behavior and a preference for quick action (Baumeister & Heatherton, 1996; Schalling, 1978), individuals elevated on the trait of impulsivity may be prone toward quick and easy ways of coping with everyday distress (e.g., by consuming alcohol), considering immediate rather than long-term effects of a coping method. Therefore, impulsivity was expected to influence alcohol-related problems via coping motives. Coping motives are considered to be more maladaptive than other drinking motives (Cooper et al., 1995; Lecci, MacLean, & Croteau, 2002; Moos, Brennan, Fondacaro, & Moos, 1990), and have been previously found to lead directly to alcohol-related problems regardless of the amount of alcohol consumed (Cooper et al., 1995; Read et al., 2003). Individuals drinking for coping reasons may drink at potentially risky times (e.g., the night before an exam) or in risky places (e.g., in a car), which increases the likelihood of problems independent of levels of alcohol use. Thus, coping motives were expected to lead directly to alcohol problems. Conformity motives were not expected to be related to the traits of sensation seeking and impulsivity. However, consistent with previous research (Cooper, 1994), conformity motives were hypothesized to have a direct relation with alcohol-related problems, but not alcohol use. Mediational pathways were tested using bias-corrected bootstrapped confidence intervals because simulation studies have demonstrated that this method provides the most accurate Type I and Type II error rates (MacKinnon, Lockwood, & Williams, 2004). Finally, given previously found gender differences in similar mediational models, potential gender invariance was tested in the current study. Specifically, in accord with previous findings (Cooper et al., 1995; Hussong et al., 2001), it was hypothesized that enhancement motives would be more strongly related to alcohol use and coping motives would be more strongly related to alcohol-related problems for men than for women.

2. Method

2.1. Participants

Participants were recruited from introductory psychology classes and other social sciences classes in exchange for extra credit. Announcements were made in class inviting students to take part in a research study by coming to the laboratory and filling out paper-and-pencil questionnaires. The sample for the current study was selected from 461 students (66% female, 34% male) participated in the study.[1] Because the correlates of drinking vary across developmental periods, the sample was restricted to those who were 24 years old or younger (*N*=408) in order to keep it homogeneous with respect to age. Also, participants who reported no alcohol consumption in the past 30 days were omitted from the sample because drinking motives (the proposed mediators in the current study) were not relevant for non-drinkers. Thus, the final sample consisted of 310 college drinkers between the ages of 18 and 24 (mean=19.4 years old; 64% female). Half of the participants (52.6%) were freshmen, 20.6% were sophomores, 10.3% were juniors, 11% were seniors, and 5.5% were beyond senior year. In

[1]The amount of missing data did not exceed 5%, therefore cases that had missing data on one or more variables used in the analyses were subjected to listwise deletion (Kline, 2005). A total of 21 (4.36%) cases were deleted from the original sample (*N*=482).

terms of self-identified ethnic background, 90% were Caucasian, 4.5% were African–American, 2.3 % were Hispanic, 1.0% were Asian, and 1.9% were "Other".

2.2. Measures

2.2.1. Personality traits—Impulsivity and sensation seeking were assessed using the English version of the Impulsiveness (10 items) and Monotony Avoidance (10 items) subscales, respectively, from the Schalling's (1978) Impulsiveness Monotony Avoidance (IMA) scale. These measures were chosen because of their more focused conceptualization of these traits as compared to other measures, which tend not to distinguish sensation seeking from impulsivity very well. Many of the most commonly used measures of impulsivity and sensation seeking contain overlapping items, making interpretation of relative contributions difficult. The IMA Impulsiveness subscale focuses on lack of planning, rapid decision-making, and carefreeness (e.g., "I have a tendency to act on the spur of the moment without really thinking ahead"). IMA Sensation Seeking items focus on a preference for change and novelty, avoiding routine, and seeking thrills and strong stimuli (e.g., "I like doing things just for the thrill of it"). Previous confirmatory factor analyses indicate that a model with impulsivity and sensation seeking as separate factors fit significantly better than a model in which they were combined into one behavioral disinhibition factor (MacLean & Magid, submitted for publication). The two subscales were found to be moderately correlated in previous studies (*r*s=.30 to .40; Schalling, 1978). The correlation was .39 in the present sample (see Table 1).

The IMA subscales were previously demonstrated to have high convergent validity, test-retest, and split–half reliability (Lennings, 1991). However, several revisions were made in the present study. The word keen was changed to *eager* in the Monotony Avoidance item "I am always keen on trying out things that are new" based on participant feedback from a small pilot study. The original true–false format was changed to a 5-point Likert scale (0="Not at all" to 4="Always") in order to create continuous measures of the two constructs. Finally, based on a previous psychometric evaluation (MacLean, Collins, Morsheimer, & Koutsky, 1999), three of the ten Impulsiveness items and four of the ten Monotony Avoidance items were dropped because of low factor loadings.[2] Both modified subscales demonstrated good convergent and discriminant validity in a recent confirmatory factor analyses (MacLean & Magid, submitted for publication). Both subscales demonstrated good internal consistency in the present sample (Cronbach's α=.71 and .83, respectively).

2.2.2. Drinking motives—Four drinking motives (affect enhancement, coping, social, and conformity) were assessed using the Drinking Motives Questionnaire (Cooper, 1994; five items each; Cronbach's αs in the present sample were .87, .85, .87, and .88, respectively). Enhancement motives for drinking were measured with items like "Because it's exciting", coping motives were measured with items like "To forget your worries", social motives were measured with items like "To be sociable", and conformity motives were measured with items like "To be liked".

2.2.3. Alcohol use—An alcohol use index was created by multiplying two questionnaire items (Armor, Polich, & Stambul, 1978), similar to those suggested by the NIAAA Task Force on Recommended Alcohol Questions (2003). These items captured frequency of consumption ("During the past 30 days, how often did you drink?") and quantity of consumption ("When you drink alcohol [beer, wine or liquor], how many drinks do you usually have?"). Descriptive information on alcohol use in the current sample in presented in Table 1.

[2]Items that were dropped from the original Impulsiveness and Monotony Avoidance measure (Schalling, 1978) were the following: "When I have to make a decision, I 'sleep on it' before I decide", "I am a very particular person", "I am a person who takes things as they come", and "I take life easy" for the Impulsiveness subscale and "I like leading a quiet and organized life", "In a way, I like to do routine jobs", and "When I listen to the radio, I want it really loud, so I can feel 'pumped'" for the Monotony Avoidance subscale.

2.2.4. Alcohol-related problems—Alcohol-related problems were measured using the Rutgers Alcohol Problem Index (RAPI; White & Labouvie, 1989; Cronbach's α=.93). The RAPI consists of 23 items and has a 5-point response scale. A person is asked to indicate how many times each negative consequence (such as "Not able to do your homework or study for a test", "Got into fights, acted bad, or did mean things") happened because of their alcohol use during the past three years ("0"=Never, "1" = 1–2 times, "2" = 3–5 times, "3" = 6–10 times, and "4"=more than 10 times). Items were summed to create a total score, which was used in the analyses.

3. Results

3.1. Analyses

Maximum likelihood estimation in Mplus version 3.12 (Muthén & Muthén, 2004) was used to estimate the models. The fully saturated model (depicted in Fig. 1) was estimated because including direct effects in a mediational model, even if they are expected to be zero, provides a more conservative test of the proposed indirect pathways. A path analysis was implemented instead of a hybrid model with latent variables in order to reduce the number of parameters estimated in the model. The exogenous variables sensation seeking and impulsivity were allowed to covary since these traits are known to be correlated (e.g., Schalling, 1978; Zuckerman, 1983). Similarly, error covariances of the four drinking motives were allowed to covary with each other (Cooper, 1994). Correlations, mean, and standard deviations are reported in Table 2.

Five hundred bootstrap samples and 99% bias-corrected confidence intervals (CIs) were used to determine the significance of the hypothesized indirect effects. When evaluating the significance of the indirect effects, the alpha level of .01 and 99% CIs were used in order to minimize capitalization on chance associations. The significance test of the mediation effects provides information regarding which indirect effects are nonzero; however, it does not provide information about magnitude of mediation (MacKinnon & Dwyer, 1993). Thus, as has been suggested previously (MacKinnon & Dwyer, 1993), the percentages of the total effects that are mediated were calculated. In doing so, all direct and indirect effects that were not significant at $p<.01$ were not considered in the calculation of total effects.

Results of the model are shown in Fig. 2. Indirect effects are presented in Table 3.

3.2. Sensation seeking

As shown in Fig. 2, sensation seeking had a significant direct effect on enhancement and social motives and alcohol use. The indirect path from sensation seeking to enhancement motives to alcohol use was statistically significant (see Table 3), such that high levels of sensation seeking were associated with high levels of enhancement motives, which in turn were associated with high levels of alcohol use. Similarly, the association between sensation seeking and alcohol-related problems was mediated by enhancement motives and subsequently by alcohol use (see Table 3). Seventy nine percent of the total effect of sensation seeking on alcohol use was mediated by enhancement motives and 21% was a direct effect. Eighty eight percent of the total effect of sensation seeking on alcohol-related problems was mediated by enhancement and alcohol use together. The remaining 13% was attributed to the direct path between enhancement motives and alcohol-related problems; however, as shown in Table 3, enhancement motives did not significantly mediate the relation between sensation seeking and alcohol-related problems.

3.3. Impulsivity

Impulsivity had a significant direct effect on coping motives, social motives, and alcohol-related problems. However, it had no significant direct or indirect effect on alcohol use (see Fig. 2 and Table 3). Coping motives significantly mediated the relationship between impulsivity and alcohol-related problems (see Table 3), such that high levels of impulsivity were associated with high levels of coping motives, which in turn were associated with higher levels of alcohol-related problems. Sixty five percent of the total effect of impulsivity on alcohol-related problems was mediated by coping motives, and the remaining 35% was a direct effect.

3.4. Model invariance across gender

Potential differences in the estimated model between males and females were first tested in an omnibus multiple group analysis. Power analysis (MacCallum, Browne, & Cai, 2006) demonstrated adequate power (.84; Cohen, 1988) to detect small between-group differences for our group sizes. All direct paths represented in Fig. 1 were constrained to be equal across groups. The chi-square difference test suggested that the constrained model resulted in a significantly worse fit than a model in which path coefficients were freed to vary across groups ($\Delta\chi^2$ =33.03, Δdf=21, p=.05), suggesting significant differences in magnitudes of path coefficients across sex. Examination of modification indices (MIs) greater than 4.0 suggested only two paths that were different between the sexes. These paths were from enhancement motives to alcohol use (MI=7.69) and from alcohol use to alcohol-related problems (MI=8.97). These paths were allowed to vary across groups, and the remaining paths were constrained to be equal. The modified model fit the data well (χ^2 =16.79, df=19, p=.60; CFI=1.0, TLI=1.0, RMSEA=.00) and no additional modification indices >4 were found. The path from alcohol use to alcohol-related problems was significant for females (b=.37, p<.01), but not males (b=.16, p>.10). The path coefficient from enhancement motives to alcohol use was significant for both females (b=.28, p<.05) and males (b=.42, p<.01), however, it was larger for males.

Tests of indirect effects across groups in the modified model with paths from enhancement motives to alcohol use and from alcohol use to alcohol-related problems suggested several gender differences. The relation between sensation seeking and alcohol-related problems was mediated by both enhancement motives and alcohol use for females (indirect effect=.08; 99% CI=.01–.22), but not males (indirect effect=.06; 99% CI=−.03–.19). Moreover, the relation between sensation seeking and alcohol use was mediated by enhancement motives for males (indirect effect=1.03; 99% CI=.36–2.09), but not females (indirect effect=.10; 99% CI=.04–.28). For females, therefore, all of the effect of sensation seeking on alcohol use was a direct effect, whereas for males 79% of the total effect of sensation seeking on alcohol use was mediated by enhancement motives and the remaining 21% was a direct effect. Furthermore, for females 82% of the total effect of sensation seeking on alcohol-related problems was mediated by enhancement motives and alcohol use. For males, on the other hand, sensation seeking did not significantly predict alcohol-related problems directly or indirectly via enhancement motives and/or alcohol use. All other indirect effects between the genders remained invariant, including a significant mediation between impulsivity and alcohol-related problems by coping motives.

4. Discussion

4.1. Summary of findings and implications

The goal of the present study was to extend recent research (MacLean & Magid, submitted for publication) by differentiating the mechanisms of risk for alcohol involvement associated with sensation seeking and impulsivity. In doing so, the study also served as a partial replication of some previous research (Cooper et al., 1995; Read et al., 2003; Simons et al., 2005) by

demonstrating the link between disinhibition personality traits, drinking motives, and alcohol-related outcomes. The present study extended the past findings by considering impulsivity and sensation seeking as separate traits assessed by validated scales (MacLean & Magid, submitted for publication; Schalling, 1978) and by considering all four drinking motives (Cooper, 1994). Furthermore, the study provided a formal test of the hypothesized mediational chains using confidence intervals obtained via the bias-corrected bootstrap procedure in order to provide a formal test of the mediational paths (MacKinnon et al., 2004). Finally, the moderating effects of gender on the proposed model were examined.

Consistent with the hypotheses, findings from the current study demonstrated differential pathways by which impulsivity and sensation seeking are linked to alcohol involvement. Specifically, most (79%) of the effect of sensation seeking on alcohol use was mediated by enhancement motives and the remainder was a direct effect. This is consistent with the theory of optimal level of arousal (Zuckerman, 1994) and past research (Cooper et al., 1995; Read et al., 2003; Simons et al., 2005). Individuals elevated on the trait of sensation seeking experience low basal levels of arousal, and may be motivated to consume alcohol to achieve an optimal level of stimulation. Alcohol is known to increase positive arousal (Connors & Sobell, 1986), and therefore, it is not surprising that we found enhancement motives were directly related to alcohol use.

Impulsivity, on the other hand, had no significant direct or indirect effects on alcohol use. Most of the influence of impulsivity on alcohol-related problems was mediated by coping motives (65%) and some of the effect was direct (35%). All of the effects of sensation seeking on alcohol-related problems were mediated by enhancement motives and alcohol use. Enhancement motives were previously found to mediate the relation between sensation seeking and alcohol-related outcomes (Cooper et al., 1995; Simons et al., 2005), which suggests that elevated levels of alcohol use will consequently lead to higher levels of alcohol-related problems among sensation seekers. Although, individuals high on the trait of sensation seeking may be motivated to engage in novel, intense, and stimulating experiences like alcohol use to increase arousal, their behavior does not necessarily reflect carelessness, lack of planning, and disregard for consequences, as does impulsivity. That is, sensation seekers may try to minimize negative consequences of their drinking (e.g., not drink before exams), and plan ahead (e.g., pre-arrange a ride home) to some degree. Therefore, very high levels of alcohol use may be necessary before individuals elevated on the trait of sensation seeking experience alcohol-related problems.

The direct and indirect mechanisms by which impulsivity influences alcohol-related outcomes are consistent with the hallmark of impulsivity, often viewed as a preference for quick action and disregard for the long-term negative consequences (Schalling, 1978). Individuals high on impulsivity appear to rely on quick and easy ways of coping with distress, such as alcohol. Coping drinking motives, in turn, were demonstrated in the current study, as well as in the past research (Cooper et al., 1995; Lecci et al., 2002), to be directly associated with alcohol-related problems and to have a stronger effect on drinking problems than other motives. Moreover, the direct impact of impulsivity on alcohol-related problems could be explained by the tendency to disregard possible negative consequences of drinking (e.g., despite an exam the next day) and drinking in risky contexts (e.g., in public places, such as parks, where drinking alcohol is illegal) by those elevated on this trait. Furthermore, such individuals may not plan ahead as they engage in alcohol consumption (e.g., not arranging a ride home, which may result in driving while intoxicated). Finally, high levels of impulsivity may be exacerbated by the disinhibiting effects of alcohol, leading to even more difficulty in regulating impulses (e.g., initiating conflicts and fights). Thus, given a general proclivity toward impulsive behavior, it may not take much alcohol to increase the likelihood of alcohol-related problems, and

consequently, levels of alcohol use, may be a less important antecedent of alcohol-related problems for individuals elevated on impulsivity.

The present study examined social and conformity motives as mediators between the personality traits and alcohol-related outcomes. Both impulsivity and sensation seeking were significantly related to social drinking motives. This finding may suggest that there may be limited utility in discerning between impulsivity and sensation seeking in predicting social drinking motives, which could be specific to college students, for whom social aspects of drinking may be particularly important. Social motives, however, were not significantly related to either alcohol use or problems. This may have been because the large amount of shared variance between enhancement and social motives (correlation of .74), left little unique variance to be explained by social motives. As predicted, neither sensation seeking nor impulsivity were significantly related to conformity motives. However, consistent with Cooper (1994), conformity motives were significantly related to alcohol problems. Future studies might consider relevant predictors of conformity motives (e.g., self-esteem, social anxiety). It is possible that disinhibited personality traits play a role in the development of conformity motives at younger ages when peer socialization is believed to be particularly strong (Kandel, 1985). Disinhibited children may engage in drinking in order to conform to their deviant peers, which in turn may result in alcohol-related problems (Dishion, Capaldi, Spracklen, & Li, 1995). Such a mechanism does not appear to be operating among college students. The utility of drinking motives as proximal predictors of alcohol outcomes was further demonstrated, suggesting that positive reinforcement motives may be better predictors of alcohol use, while negative reinforcement motives may be more important predictors of problematic drinking.

The test of gender moderation revealed only two paths that differed between males and females. Specifically, a path from enhancement motives to alcohol use was stronger for males and the path from alcohol use to alcohol-related problems was stronger for females. Furthermore, it was demonstrated that enhancement motives play an important role in mediating the relation between sensation seeking and alcohol use for males, but not females. Enhancement motives and subsequently alcohol use mediated the relation between sensation seeking and alcohol-related problems for females only. For males, on the other hand, sensation seeking did not play a role in influencing alcohol problems directly or indirectly. These gender differences are partly consistent with the findings of Cooper et al. (1995), who reported stronger effects of enhancement motives on alcohol use for males as compared to females. In contrast with Cooper et al. (1995), the present study demonstrated the relation between coping motives and alcohol-related problems to be invariant across gender. Cooper et al. (1995), however, reported only a difference in magnitude, not in significance or direction of this effect between genders.

4.2. Conclusions and intervention implications

The patterns of findings suggest that narrow constructs of sensation seeking and impulsivity are differentially related to alcohol use and alcohol-related problems, such that impulsivity is more strongly related to alcohol problems, whereas sensation seeking is more strongly related to alcohol use. These results suggest that the prevention and intervention programs may benefit from including different strategies for individuals high on the trait of impulsivity versus sensation seeking based on their respective proximal risk factors for alcohol involvement. Alternative strategies for coping with stress, as well as self-regulation training, might be most helpful for the individuals elevated on impulsivity. In contrast, individuals high on sensation seeking might benefit from learning alternative strategies for increasing positive arousal. Finally, unlike for males, alcohol-related problems for females are more strongly linked to the levels of alcohol use. Therefore, amount of alcohol problems experienced by college females may be more significantly reduced just by monitoring and reducing the amount of alcohol consumption.

4.3. Limitations and directions for future research

The results of the present study should be considered in light of several methodological limitations, such as the reliance upon cross-sectional, self-report data. Although most of the hypothesized relationships are unlikely to be causally reversed, appropriate caution should be exercised in drawing causal inferences from the data. For example, alcohol motives and alcohol outcomes may be reciprocally related (e.g., Stacy, Leigh, & Weingardt, 1994; Aas, Leigh, Andersen, & Jakobsen, 1998). In future research, it will be important to replicate the current findings by testing the mediational model in a longitudinal sample to establish temporal precedence.

Additionally, the current sample consisted of predominantly Caucasian (90%) participants, thus restricting the generalizability of the results. It is also important to note that "non-drinkers" were deleted from the analyses based on reported alcohol use in the past 30 days. This criterion may have omitted a small number of participants who were light drinkers and consumed alcohol less than once a month. Thus, the current findings cannot be generalized to these drinkers. Moreover, no information was collected with respect to the diagnostic criteria for alcohol disorders in the current sample. Future studies may want to examine the role of assessments of sensation seeking and impulsivity in diagnosis and treatment planning for individuals meeting criteria for alcohol-related disorders.

It should also be noted that the timeframes provided for alcohol use and alcohol-related problems were different. A three-year timeline was used to assess alcohol-related problems to avoid restricted range of responses because a number of items tend to occur at a low base rate in non-clinical samples. Despite the timeline discrepancy, the obtained correlation of .43 between these two measures is consistent with the moderate association usually found in the literature for adolescents and college students (e.g., correlation of .49 in Cooper et al., 1995).

Finally, it should be noted that, guided by the study goals, we chose one of the many definitions of impulsivity that exist in the literature. It is possible that the use of other narrow definitions, such as cognitive impulsivity (Patton, Stanford, & Barrat, 1995), may result in a different pattern of findings. Even though the present study focused on a more common conceptualization of impulsivity, future research might examine the mechanisms by which other narrow conceptualizations of impulsivity may lead to alcohol involvement.

These limitations notwithstanding, the results of the current study indicate that sensation seeking and impulsivity differentially impact alcohol use and alcohol-related problems and they do so via different pathways (i.e., drinking motives), thus underscoring the importance of distinguishing between the traits of sensation seeking and impulsivity in predicting alcohol-related outcomes among college students. Moreover, the study demonstrated robustness of the results across gender, with only two relationships differing between males and females.

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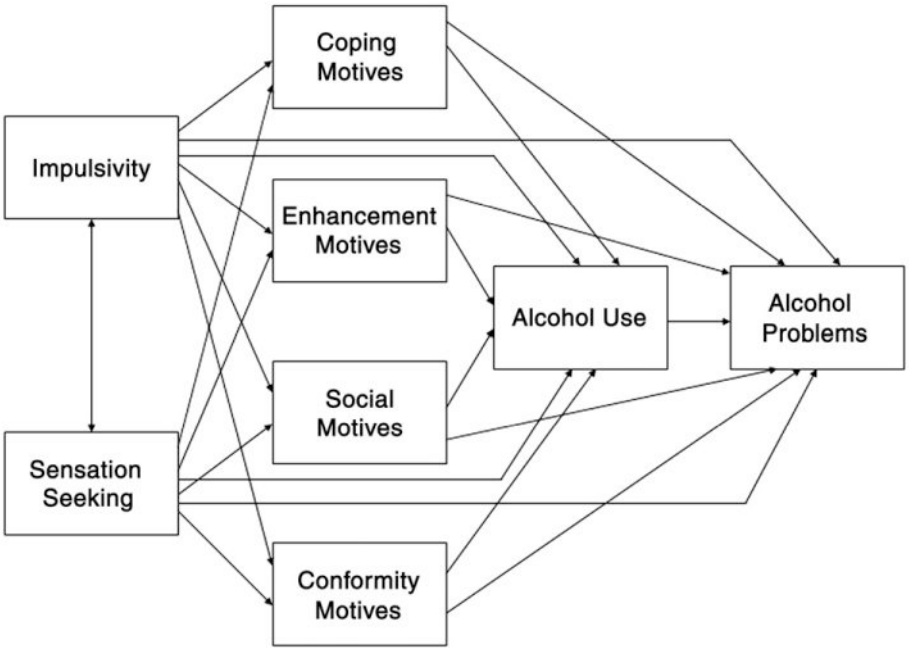

Fig. 1.
Estimated model. Covariances between the four drinking motives were estimated, but excluded from the figure for the clarity of presentation.

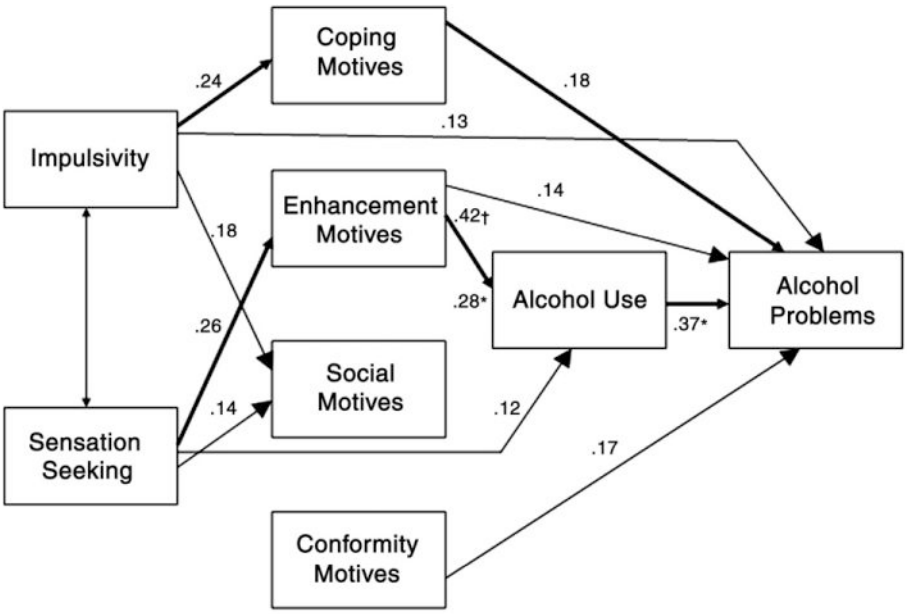

Fig. 2.

Results of the path model. Only significant standardized effects at $p<.01$ are shown. For paths that significantly differed across sex, coefficients for males and females are presented († path coefficient for males; * path coefficient for females). Paths in bold represent significant indirect effects. Covariances between the four drinking motives were estimated, but excluded from the figure for the clarity of presentation. Estimated correlations: coping motives with enhancement motives=.36, coping motives with social motives=.34, coping motives with conformity motives=.35, enhancement motives with social motives =.66, enhancement motives with conformity motives=.15, social motives with conformity motives=.16. Proportion of variance accounted for by the model (R^2) in the outcome variables: coping motives=.07, social motives=.07, enhancement motives=.11, conformity motives=.01, alcohol use=.25, alcohol-related problems =.35.

Table 1

Number and percentage of participants for each response on scales of frequency and quantity of alcohol use for the overall sample, males, and females

	Total (*N*=310)	Males (*N*=111)	Females (*N*=199)
Frequency			
Once during the past month	50 (16%)	17 (15%)	33 (17%)
2–3 times during the past month	106 (34%)	24 (22%)	82 (41%)
Once or twice a week	112 (36%)	50 (45%)	62 (31%)
3–4 times per week	37 (12%)	17 (15%)	20 (10%)
Nearly every day	5 (2%)	3 (3%)	2 (1%)
Quantity per occasion			
Part or all of one drink	25 (8%)	9 (8%)	16 (8%)
2 drinks	29 (9%)	6 (5%)	23 (12%)
3 drinks	51 (17%)	11 (10%)	40 (20%)
4 drinks	54 (17%)	9 (8%)	45 (23%)
5–6 drinks	66 (22%)	23 (22%)	43 (22%)
7–9 drinks	49 (16%)	26 (25%)	20 (9%)
9–10 drinks	13 (4%)	4 (4%)	9 (5%)
More than 10 drinks	23 (7%)	20 (18%)	3 (2%)

Frequency and quantity of alcohol use were assessed with the questions “During the past 30 days how often did you drink?” and “When you drank alcohol over the past 30 days, how many drinks did you usually have?”, respectively. The average alcohol use frequency for the overall sample was “Once or twice a week”. The average alcohol use quantity for the overall sample was “5–6 drinks”.

Table 2

Intercorrelations, means, and standard deviations

	1	2	3	4	5	6	7	8	Mean	SD
Impulsivity	1								11.46	3.99
Sensation seeking	.39**	1							16.91	4.51
Coping motives	.26**	.14*	1						9.72	3.79
Social motives	.24**	.21**	.41**	1					14.26	3.86
Enhancement motives	.23**	.30**	.43**	.74**	1				12.96	4.09
Conformity motives	.09	−.03	.37**	.17**	.16**	1			6.73	2.84
Alcohol use	.20**	.27**	.18**	.40**	.47**	.01	1		29.49	34.96
Alcohol-related problems	.29**	.21**	.39**	.37**	.42**	.27**	.43**	1	13.12	14.27

Correlations, means, and standard deviations for males and females separately are available upon request.

SD = standard deviation.

** $p<.01$,

* $p<.05$.

Table 3

Indirect effects on alcohol use and alcohol-related problems and their respective confidence intervals

	Indirect effect	99% CI
Sensation seeking effects		
Sensation seeking→coping→use	−.01	(−.17, .06)
Sensation seeking→coping→problems	.03	(−.06, .17)
Sensation seeking→coping→use→problems	.00	(−.02, .01)
Sensation seeking→enhancement→use	.71*	(.28, 1.45)
Sensation seeking→enhancement→problems	.11	(−.03, .29)
Sensation seeking→enhancement→use→problems	.09*	(.03, .22)
Sensation seeking→social→use	.13	(−.04, .56)
Sensation seeking→social→problems	.00	(−.10, .11)
Sensation seeking→social→use→problems	.02	(−.01, .07)
Sensation seeking→conformity→use	.04	(−.04, .35)
Sensation seeking→conformity→problems	−.04	(−.23, .04)
Sensation seeking→conformity→use→problems	.01	(.00, .05)
Sensation seeking→use→problems	.11	(−.03, .25)
Impulsivity effects		
Impulsivity→coping→use	−.07	(−.58, .25)
Impulsivity→coping→problems	.15*	(.03, .43)
Impulsivity→coping→use→problems	.01	(−.09, .04)
Impulsivity→enhancement→use	.40	(−.03, .99)
Impulsivity→enhancement→problems	.06	(−.02, .25)
Impulsivity→enhancement→use→problems	.05	(.00, .17)
Impulsivity→social→ use	.18	(−.03, .57)
Impulsivity→social→problems	.00	(−.17, .15)
Impulsivity→social→use→problems	.02	(.00, .08)
Impulsivity→conformity→ use	−.06	(−.32, .06)
Impulsivity→conformity→problems	.07	(−.01, .24)
Impulsivity→conformity→use→problems	−.01	(−.04, .01)
Impulsivity→use→problems	.06	(−.09, .24)

Unstandardized path coefficients were used in computing the indirect effects. 99CI = 99% confidence intervals; coping = coping motives; enhancement = enhancement motives; social = social motives; conformity = conformity motives; use = alcohol use; problems = alcohol-related problems.

* Significant indirect effect (i.e., confidence interval does not include zero).