



Acute subjective response to alcohol as a function of reward and punishment sensitivity



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HIGHLIGHTS

- Tested how reward and punishment sensitivity affects subjective alcohol response
- Reward hypersensitivity related to greater, more protracted feelings of stimulation
- Punishment sensitivity was unrelated to feelings of sedation after drinking.
- Drinkers hypersensitive to reward are more receptive to rewarding alcohol effects.

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ABSTRACT

Individual differences in subjective response to alcohol play a crucial role in the development of heavy drinking and related problems. In light of this, a growing focus of research has been identifying factors that contribute to differences in response. The aim of the present study was to determine whether individual differences in the subjective experience of rewarding and aversive effects of alcohol are a specific manifestation of general differences in reward and punishment sensitivity. Eighty-nine participants (M age = 22.4, SD = 1.9; 47.2% women) consumed a moderate dose of alcohol, i.e., peak breath alcohol concentration (BrAC) \approx 0.080 g%, and rated their level of stimulation and sedation at seven timepoints over the BrAC curve. Sensitivity to reward and punishment were assessed by a self-report questionnaire prior to consumption. Multilevel growth models showed that post-consumption changes in stimulation ratings varied as a function of participants' level of reward and punishment sensitivity. Drinkers more sensitive to reward reported feeling more stimulated shortly after drinking and exhibited an attenuated rate of decline in stimulation over the blood alcohol curve, relative to drinkers with less strong reward sensitivity. Reward sensitivity was not related to subjective ratings of sedation, and punishment sensitivity was not related to either stimulation or sedation ratings. Findings suggest that reward sensitivity may increase risk for alcohol misuse among young adult social drinkers by increasing their subjective feelings of stimulation while drinking.

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1. Introduction

Considerable research and theory associates personality traits with problem drinking (for reviews, see Lejuez et al., 2010; Stautz & Cooper, 2013). Of the various ways that personality promotes alcohol misuse (Littlefield & Sher, 2010), one that has gained increasing research attention is the contribution of personality to subjective response to alcohol (Erblich & Earleywine, 2003; Leeman et al., 2014; Scott & Corbin, 2014). Subjective response is implicated in virtually all theoretical models of alcohol misuse (Newlin & Renton, 2010; Schuckit, 2009). Response models emphasize the importance of alcohol's reinforcing

effects, such that drinking is largely motivated by the prospect of enhancing positive subjective states and/or alleviating negative subjective states (Cox & Klinger, 1988; Pihl & Peterson, 1995). Accordingly, models of personality that incorporate motivational factors, such as Gray's reinforcement sensitivity theory (RST; Gray, 1987a, 1987b; Gray & McNaughton, 2000), provide a particularly useful framework for examining the association between personality and subjective response to alcohol.

1.1. Reinforcement sensitivity theory

Gray's RST (for a review, see Corr, 2008) attributes differences in personality to stable variations in the reactivity of two biologically-based motivational systems—the Behavioral Approach System (BAS) and the Behavioral Inhibition System (BIS). These systems regulate

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responses to potential reward and punishment and may help to explain differences in subjective response to alcohol's rewarding and aversive effects. The BAS regulates response to reward-related stimuli by motivating appetitive behavior and increasing positive affect (e.g., elation, happiness; Corr, 2008). Thus, this system may promote drinking through positive reinforcement mechanisms—by activating response to the rewarding and stimulatory effects of alcohol (Pihl & Peterson, 1995). It follows that individuals with greater BAS sensitivity may be at elevated risk for alcohol misuse because they are more receptive to alcohol's stimulatory effects (Dawe, Gullo, & Loxton, 2004). This notion is indirectly supported by evidence that higher scores on BAS-related measures correlate with more positive expectancies about alcohol use (Gullo, Dawe, Kambouropoulos, Staiger, & Jackson, 2010), increased appetitive motivation (i.e., urge to drink) in response to alcohol cues (Kambouropoulos & Staiger, 2004), and more frequent and heavier alcohol use (Johnson et al., 2003; Lyvers, Czerczyk, Follent, & Lodge, 2009; O'Connor & Colder, 2005; Pardo et al., 2007).

The relation of the BIS to alcohol misuse is less straightforward. In the most recent formulation of the RST (Gray & McNaughton, 2000), the BIS is thought to resolve conflict in mixed-incentive situations by evaluating the aversiveness of a situation and determining approach or avoidant behavior (Corr, 2008). Thus, either elevated or reduced BIS sensitivity may contribute to heavy drinking. Elevated BIS sensitivity may increase attentional bias for potential signs of punishment, thereby producing emotional distress and promoting alcohol use as a coping mechanism (Corr, 2008; Pihl & Peterson, 1995). Alternatively, attentional bias for punishing effects of alcohol may heighten conflict in the BIS system, creating behavioral ambivalence which could serve to limit drinking (Keough & O'Connor, 2014). Alternatively, reduced BIS sensitivity may cause potential warning signs of punishment (e.g., impaired coordination, nausea) to be neglected, thereby fostering heavy drinking (Cox & Blount, 1998; Kimbrel, Nelson-Gray, & Mitchell, 2007; Pardo, Aguilar, Molinuevo, & Torrubia, 2007). Lastly, the association between BIS and alcohol use may also be a result of co-occurring psychopathology (see Loxton & Dawe, 2001).

1.2. BIS/BAS and subjective alcohol responses

There is scarce empirical research examining how BIS and BAS sensitivities affect individual subjective response to alcohol. One relevant study tested whether urge to drink following a sip of alcohol are moderated by BIS and BAS sensitivity; regular drinkers who were hypersensitive to reward reported stronger urges to drink following a sip of alcohol (Kambouropoulos & Staiger, 2001, 2004). In the only study to test the association of BIS and BAS sensitivities with acute response to a moderate dose of alcohol, Brunelle et al. (2004) found greater BAS, but not BIS, sensitivity was associated with elevated heart rate response, an objective measure of alcohol-induced stimulation, during intoxication. Thus, variation in BAS sensitivity may influence intoxicated experience, but inconsistency in the relation of objective and subjective indices of alcohol response make the applicability of these findings to subjective response unclear (Brunelle, Barrett, & Pihl, 2007; Ray, McGeary, Marshall, & Hutchinson, 2006).

To date, most studies examining the association between personality and subjective response to alcohol have focused on traits such as sensation seeking (Scott & Corbin, 2014), impulsiveness (Leeman et al., 2014), and behavioral undercontrol (Erblich & Earleywine, 2003). However, factor analytic studies indicate that these traits are only modestly related to BIS- and BAS-mediated traits (Caseras, Ávila, & Torrubia, 2003; Depue & Collins, 1999; Franken & Muris, 2006a, 2006b; Quilty & Oakman, 2004; Zelenski & Larsen, 1999). Therefore, additional research is needed to determine whether subjective experiences of the rewarding and aversive effects of alcohol are specific manifestations of stable differences in BIS and BAS sensitivity.

1.3. The present research and hypotheses

This study is the first to investigate whether variation in BIS and BAS sensitivities moderate the extent to which young adult drinkers respond subjectively to a moderate dose of alcohol. Presently, there is no gold-standard measure to evaluate BIS sensitivity as theorized in the revised RST (see Smillie, Pickering, & Jackson, 2006). Of self-report questionnaires based on the original theory, the Sensitivity to Punishment and Sensitivity to Reward Questionnaire (SPSRQ; Torrubia, Ávila, Moltó, & Caseras, 2001) appears to adhere most closely to the essential features of Gray's theory and has been recommended for the assessment of the BIS and BAS (Caseras et al., 2003). This measure includes Sensitivity to Punishment (SP) and Sensitivity to Reward (SR) scales designed to evaluate individual variation in the functioning of BIS and BAS, respectively. Thus, this measure was used to apply Gray's RST to understanding individual differences in subjective responses to alcohol.

On the whole, alcohol produces stimulant effects shortly after consumption when blood alcohol concentration (BAC) levels are increasing and produces sedative effects when BAC levels decline (King, McNamara, Hasin, & Cao, 2014; Ray, MacKillop, & Monti, 2010a; Ray et al., 2010b). We employed the Biphasic Alcohol Effects Scale (BAES; Martin, Earleywine, Musty, Perrine, & Swift, 1993) in the present study to capture these disparate effects. This measure was specifically designed to assess alcohol's positively reinforcing stimulant effects (e.g., elation, excitement, vigor) and its aversive sedative effects (e.g., difficulty concentrating, sluggishness; Hendler, Ramchandani, Gilman, & Hommer, 2013). Moreover, it has been used extensively in alcohol administration studies (Quinn & Fromme, 2011).

Given that BAS hypersensitivity is associated with heavy drinking (Lyvers et al., 2009; O'Connor & Colder, 2005; Pardo et al., 2007), we anticipated that greater BAS/SR would be related to increased subjective stimulation, especially early in the course of intoxication when BAC levels rise. Elevated BIS sensitivity is believed to increase attentional bias for potential signs of punishment (Corr, 2008). Given that the BAES primarily captures the aversive, sedative effects of alcohol, we anticipated that greater BIS/SP would be associated with increased subjective sedation, particularly later in the course of intoxication when BAC levels decline. However, this expectation was tentative due to inconsistent findings for the association of BIS functioning and heavy drinking.

Previous research has identified several other variables that influence how responsive individuals are to the acute subjective effects of alcohol. For instance, studies suggest that the sedative effects of alcohol tend to be more pronounced at higher blood alcohol concentrations (Holdstock & de Wit, 1998; Leeman et al., 2014; Pohorecky, 1977). Furthermore, heavier drinkers typically report more pronounced stimulation with ascending BAC levels and less sedation with declining BAC than lighter drinkers (Holdstock, King, & de Wit, 2000; King, de Wit, McNamara, & Cao, 2011; King et al., 2014). To account for the effects of these variables on subjective response, we included BrAC and typical drinking quantity as within- and between-person variables, respectively. Sex was also included to account for differences between males and females in the pharmacological actions of alcohol (Thomasson, 2002).

2. Materials and methods

2.1. Participants

Eighty-nine young adults (47.2% women) between the ages of 21 and 30 years old (M age = 22.4, SD = 1.9) participated. Participants were predominantly Caucasian (n = 78; 87.6%), with four African-Americans, two Asian Americans, one Pacific Islander, and three who reported multiple races (one participant reported their race as "Other"). This sample has been previously reported on in another publication testing the effects of alcohol on perceptions about driving after drinking (Morris, Treloar, Niculete, & McCarthy, 2014).

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