



Response inhibition toward alcohol-related cues using an alcohol go/no-go task in problem and non-problem drinkers



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HIGHLIGHTS

- Response inhibition to alcohol cues is studied using a modified go/no-go task.
- Reduced reaction times and higher false alarms are observed for alcohol cues.
- Problem drinkers show faster reaction times for alcohol cues without brand logos.
- Alcohol brand logos affect reaction times only in non-problem alcohol drinkers.

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ABSTRACT

Background: Previous results suggested that alcohol abusers and alcohol dependent patients show cognitive biases in the treatment of alcohol-related cues, especially approach and inhibition deficit biases. Response inhibition was often tested using the go/no-go task in which the participants had to respond as quickly as possible to a class of stimuli (go stimuli) while refraining from responding to another class of stimuli (no-go stimuli). Previous studies assessing specific response inhibition deficits in the process of alcohol-related cues obtained conflicting results. The aims of the present study were to clarify response inhibition for alcohol cues in problem and non-problem drinkers, male and female and to test the effect of alcohol brand logos.

Methods: Thirty-six non-problem drinker and thirty-five problem drinker undergraduate students completed a modified alcohol go/no-go task using alcohol and neutral object pictures, with or without brand logos, as stimuli. An additional control experiment was carried out to check whether participants' awareness that the study tested their response to alcohol might have biased the results.

Results: All participants, whether problem or non-problem drinkers, showed significantly shorter mean reaction times when alcohol pictures are used as go stimuli and significantly higher percentages of commission errors (false alarms) when alcohol pictures are used as no-go stimuli. Identical effects were obtained in the control experiment when participants were unaware that the study focused on alcohol. Shorter reaction times to alcohol-related cues were observed in problem drinkers relative to non-problem drinkers but only in the experimental condition with no brand logos on alcohol pictures. The addition of alcohol brand logos further reduced reaction times in light drinkers, thereby masking group differences. There was a tendency for female problem drinkers to show higher rates of false alarms for alcohol no-go stimuli, although this effect was only very close to statistical significance.

Conclusions: All participants exhibited a cognitive bias in the treatment of alcohol cues that might be related to the positive emotional value of such alcohol-related cues. Stronger cognitive biases in the treatment of alcohol cues were observed in problem drinkers, although differences between problem and non-problem drinkers were relatively small-scale and required specific experimental parameters to be uncovered. In particular, the presence of alcohol brand logos on visual alcohol cues was an important experimental parameter that significantly affected behavioral responses to such stimuli.

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1. Introduction

Alcohol dependence is characterized by alcohol craving and consumption despite destructive consequences on physical, social and occupational fields (Diagnostic and Statistical Manual of Mental Disorders-Fourth Edition, DSM-IV, American Psychiatric Association,

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1994; Lowman, Hunt, Litten, & Drummond, 2000). Several recent models of the development of alcohol dependence refer to dual-process theories suggesting that addictive behaviors are the result of an imbalance between two neurocognitive systems (Deutsch & Strack, 2006; Wiers & Stacy, 2006; Wiers et al., 2007). On one hand, an appetitive system triggers automatic and fast appetitive responses to alcohol-related cues. According to the model, this system might become sensitized following chronic alcohol consumption (Robinson & Berridge, 1993). On the other hand, a conscious executive system is supposed to regulate consumption behaviors, but this system is compromised after regular alcohol abuse (Parsons, 1998). As a consequence, when alcohol abusers are confronted with alcohol-related cues, there is an automatic activation of the appetitive system, leading to approach behaviors toward alcohol and alcohol craving (Wiers et al., 2007). As the inhibitory system is compromised, their ability to inhibit these responses is reduced, which leads to an apparent compulsive use of alcohol (Wiers et al., 2007).

Regarding the inhibitory system, many published studies showed a reduced general ability of inhibition in alcoholics. For example, they have difficulties delaying gratification (Bickel & Marsch, 2001; Bjork, Hommer, Grant, & Danube, 2004), they are less efficient in the manipulation of information in working memory (Bechara & Martin, 2004; Noël et al., 2001), they show an impaired response inhibition (Noël et al., 2001; Zago-Gomes & Nakamura-Palacios, 2009) and they have a poorer capacity of flexibility (Ratti, Bo, Giardini, & Soragna, 2002). Some results suggest that a weak response inhibition might precede the development of alcohol dependence. For example, poor inhibition performances were reported in children from families at high risk for developing alcoholism (Hill, Louters, Locke, Snidman, & Kagan, 1999; Sher et al., 1991) and in untreated social drinkers (Montgomery, Fisk, Murphy, Ryland, & Hilton, 2012). Furthermore, inhibition capacities during childhood were shown to predict future drinking problems (Nigg et al., 2006). While inhibition deficits might be a cause or a consequence of alcohol abuse (or even both of them together), it is clear that they contribute to maintain alcohol abuse.

Chronic alcohol consumption not only impairs executive functions but also leads to an automatic tendency of the appetitive system to process alcohol-related cues. This has been demonstrated using several experimental paradigms and especially by testing attentional biases for alcohol-related cues. Several studies demonstrated that alcohol abusers and alcohol dependent patients show such attentional biases (for review see Field & Cox, 2008). For example, heavy drinkers are slower than light drinkers to name the colors of alcohol-related words in a modified-Stroop paradigm (Field, Christiansen, Cole, & Goudie, 2007). This suggests that heavy drinkers have difficulties disengaging their attention from these stimuli. Using a visual dot-probe paradigm, Townshend and Duka (2001) also show that heavy drinkers are faster to detect a target when displayed behind an alcohol-related picture. By manipulating the time interval between the presentations of the alcohol-related picture and the target in the visual dot-probe task, Noël et al. (2006) found an attentional bias for alcohol-related cues in detoxified alcoholic patients with a 50 ms time interval, but not with 500 ms. This suggests that detoxified alcoholic patients are characterized by an initial orientation bias toward alcohol-related cues. In addition to attentional biases, approach biases for alcohol-related stimuli were also reported in heavy drinkers. Using approach/avoidance tasks, two studies showed that heavy drinkers are faster to provide approach responses toward alcohol-related pictures relative to avoid responses (Field, Kiernan, Eastwood, & Child, 2008; Wiers, Rinck, Dictus, & van den Wildenberg, 2009). Taken together, these results support the theory that alcohol-related cues are processed in a relatively automatic and spontaneous way in heavy drinkers. With the addition of the inhibition deficits reported above, it was hypothesized that alcohol-related cues capture attention and elicit approach behaviors in alcohol abusers, eventually leading to uncontrolled alcohol consumption.

Whereas a number of studies have investigated general inhibition functions in social drinkers and alcohol dependent patients, fewer studies have tested the response inhibition specifically to alcohol-related cues. As alcohol abusers show general inhibition deficits together with attentional and approach biases for alcohol-related cues, the strongest response inhibition deficits might be expected for such specific stimuli in those subjects. Specific inhibition responses for alcohol-related cues were mainly tested using either the go/no-go or the stop signal tasks. In the go/no go task, the participants have to respond as quickly as possible to a class of stimuli (go stimuli) while refraining from responding to another class of stimuli (no-go stimuli). In the stop signal task, participants have to refrain a highly trained response when the response cue is followed by a specific stop signal. However, it is currently difficult to draw a clear conclusion from such studies using alcohol-related cues, as they have used different methodological parameters and reported conflicting results. Using a go/no go task with alcohol-related words, Noël et al. (2007) showed that both alcoholic patients and control participants were faster to respond when go stimuli are alcohol-related words as opposed to neutral words. However, alcoholic patients made significantly more commission and omission errors, which might be interpreted as a general response inhibition deficit in recently detoxified alcoholics. Although Noël and colleagues reported their results as an evidence of higher inhibition deficits specifically for alcohol-related words in alcoholic patients, such an interpretation was contested (Field & Cole, 2007).

To test for potential differences in response inhibition toward alcohol-related cues in heavy and light drinkers, Nederkoorn, Baltus, Guerrieri, and Wiers (2009) used a modified stop signal task. Although they found no differences between heavy and light drinkers in response inhibition toward alcohol-related pictures, they observed stronger inhibition deficits in heavy drinking women but this effect was not specific to alcohol-related cues. Other studies found conflicting results regarding response inhibition toward alcohol-related cues. In a study from Rose and Duka (2008) using alcohol pictures in moderate-to-heavy drinkers, slower responses were found for alcohol-related cues. In contrast, Adams, Ataya, Attwood, and Munafò (2013) showed faster responses to alcohol-related cues, although no clear differences were observed between heavy and light social alcohol users. In these two latter studies, the effects of alcohol administration were also different. In the study from Rose and Duka (2008), the administration of a moderate alcohol dose had no specific effect on response inhibition to alcohol cues in a go/no-go task, whereas alcohol administration reduced response inhibition, specifically to lexical alcohol-related cues (words), in the study from Adams et al. (2013). It is therefore difficult to draw clear conclusions from these few studies. It is however possible to point to some experimental parameters likely to affect the results. First, the alcohol consumption status of the participants is likely to play a role. Whereas a specific inhibition bias for alcohol-related cues was reported in alcohol dependent patients (Noël et al., 2007), no differences between light and heavy drinkers were found to date (Adams et al., 2013; Nederkoorn et al., 2009). However, differences between light and heavy drinkers are expected on theoretical grounds, as cognitive biases toward alcohol-related cues are expected to slowly develop with heavy alcohol consumption. Considering the conflicting nature of the results of previous studies, differences between problem and non-problem drinkers should be retested using different experimental parameters. Gender is another important parameter as stronger general inhibition deficits were observed in heavy drinking women relative to men (Nederkoorn et al., 2009). Finally, the type of alcohol-related cues might also seriously affect the results. In the study from Adams et al. (2013), specific response inhibition deficits were recorded when alcohol-related words were used as targets, but not with alcohol pictures.

In the present study we tested response inhibition toward alcohol-related cues in problem and non-problem drinkers, men and women using a modified alcohol go/no-go task. Alcohol pictures were used

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