



# Longitudinal relations between cognitive bias and adolescent alcohol use<sup>☆</sup>



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## HIGHLIGHTS

- We examined whether cognitive biases and impulsivity predicted alcohol use.
- We examine interaction between impulsivity and alcohol on future cognitive bias.
- We found that attention bias predicted future alcohol use.
- We did not find that impulsivity, alcohol or interactions predicted cognitive bias.

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## ABSTRACT

**Introduction:** To prospectively predict the development of adolescent alcohol use with alcohol-related cognitive biases, and to predict the development of alcohol-related cognitive biases with aspects of impulsivity.

**Methods:** Data were used from a two-year, four-wave online sample of 378 Dutch young adolescents (mean age 14.9 years, 64.8% female). With zero-inflated Poisson regression analysis we prospectively predicted weekly alcohol use using baseline cognitive biases. Additionally, multiple regression analyses were used to prospectively predict the emergence of alcohol-specific cognitive biases by baseline impulsivity and alcohol use.

**Results:** Zero-inflated Poisson analyses demonstrated that the Visual Probe Task reliably predicted weekly alcohol use at different time points. Baseline alcohol use and baseline impulsivity measures did generally not predict alcohol-specific cognitive biases.

**Conclusions:** The findings of this study indicated that while certain measures of alcohol-related attentional bias predicted later alcohol use in young adolescents, approach biases did not. Baseline measures of impulsivity and alcohol use did not predict later alcohol-related cognitive biases. We discuss implications for cognitive models on the development of cognitive biases and their role in early addictive behaviors.

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## 1. Introduction

Research in undergraduate populations have linked alcohol-related cognitive biases to alcohol use, with heavy drinkers reporting a stronger attentional bias (Field, Mogg, Zetteler & Bradley, 2004) and approach-bias (Field, Kiernan, Eastwood & Child, 2008) for alcohol compared to light drinkers. Alcohol-related cognitive biases are thought to promote drinking in a relatively automatic way (Gladwin, Figner, Crone & Wiers, 2011). Dual process theories of addiction (e.g. Bechara, 2005; Stacy & Wiers, 2010) emphasize interplay between on the one hand

relatively automatic or impulsive process such as selective attention and approach action-tendencies to alcohol-related cues, and on the other hand reflective, top-down processes that may moderate the impulsive alcohol-related reactions. While research has indicated that alcohol-related cognitive biases predicted alcohol use in heavy drinking adolescents (Field, Christiansen, Cole & Goudie, 2007; Field, Kiernan, Eastwood and Child, 2008; Peeters et al., 2012), little is known about the development of alcohol-related cognitive biases in early adolescence. For example, at present it is unknown whether early alcohol-related cognitive biases emerge as a consequence of alcohol use, or predate alcohol use as an alcohol-specific expression of more general pre-existing traits such as impulsivity. Therefore, the current study examined the development and interplay between alcohol-specific cognitive biases and emerging alcohol use in adolescence, and to what extent cognitive biases can be predicted by general impulsivity-related measures and alcohol use.

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It is generally accepted that adolescents experience a period of heightened sensitivity to reward and greater impulsivity resulting in greater risk taking, and that this period coincides with an increased likelihood of substance use onset. Specifically, studies suggest that risk taking shows an inverted U-shape pattern during adolescence, showing a decline after peaking in adolescence (Steinberg, 2004), and that this impulsivity prospectively predicts binge drinking, with binge drinking in turn also predicting a non-permanent increase in impulsivity (White et al., 2011). Animal studies further suggest that during this period, adolescents are conditioned to rewarding substances more rapidly (Brenhouse & Andersen, 2008). In humans, alcohol-related cognitive biases are believed to affect behavior through the interplay of dual processes. Current interpretations of dual process models (Gladwin, Figner, Crone and Wiers, 2011) suggest that this adolescent peak in impulsivity is represented as a delay in the development of top-down controlled, long term oriented motivation, and may coincide with the inverted U-shape pattern of impulsivity. This delay increases the likelihood of immediate responses being selected. A relevant example of top-down controlled, long term motivated decision making would be to hold off on going out with friends for a night of drinking because one has an important exam the following morning, which represents a deliberate effort to shift focus from immediate reward to long-term objectives. The strength of immediate responses may be influenced by reward learning that emphasizes the rewarding properties of the associated outcomes to these responses. These findings raise interest in examining the relation of alcohol-related cognitive biases and impulsivity to early substance use in human adolescents.

Regarding the relation between impulsivity and alcohol-related cognitive bias, a recent meta-analysis (Coskunpinar & Cyders, 2013) examined results from 13 studies, finding that there existed a consistent positive relation between both self-report and behavioral impulsivity on the one hand, and attentional bias on the other, with stronger findings for behavioral impulsivity. This study suggested a model relating impulsivity to attentional bias through both biasing of classical conditioning and affecting dopaminergic responses. Both these processes would serve to let aspects of impulsivity speed up the development of attentional biases given substance exposure. Although these findings pertained to attentional bias and were not exclusive to alcohol as a bias target, the implications from this model are that aspects of impulsivity, particularly behavioral as opposed to self-report, could be predictive prospectively of greater alcohol-specific cognitive bias. Incentive learning models suggest that this prospective prediction might be moderated by alcohol use, through the development of incentive sensitization (Berridge, Robinson & Aldridge, 2009), which could in humans be expressed in an attentional bias and approach bias (Berridge, Robinson & Aldridge, 2009; Stacy & Wiers, 2010). As mentioned in the meta-analysis (Coskunpinar & Cyders, 2013), all study data examined were cross-sectional, and there exists a need for causal and longitudinal data to effectively examine the precise nature of the interplay of these processes.

The current study was designed to investigate the role of alcohol-related cognitive biases and their relation to aspects of impulsivity as well as alcohol use in a sample of early adolescents in an online longitudinal study. Bias measures and alcohol use were measured at four six-month intervals, as well as self-reported impulsivity at baseline, allowing the examination of prospective relations between these measures. When predicting alcohol use, we hypothesized that later heavy drinkers would show greater baseline alcohol-related cognitive biases than later light drinkers, but only for those who were current drinkers. In accordance with dual process theory, we hypothesized that the interaction between impulsivity-traits and alcohol use would prospectively predict bias scores at later time points. We conducted two zero-inflated Poisson (ZIP) regression analyses to predict alcohol use after a short (6-month) and long (18-month) interval by bias measures on the one hand, and conducted multiple linear regression analyses to predict bias measures with impulsivity measures and drinking history on the other hand.

## 2. Methods

### 2.1. Participants

The current sample (N = 378, M age 14.9 years, SD = 1.28, range: 12–18 years, 64.8% female) is defined as those participants who successfully completed participation during at least one time point. Within this sample, 210 participants completed participation at Time 2, 182 participants at Time 3, and 195 participants at Time 4. Participants were recruited from an earlier classroom survey for the Health Behaviors in School-aged Children-project (Van Dorsselaer et al., 2013). Recruitment was presented as an opportunity to engage in a more elaborate online research project which was separate from and additional to the original classroom-based project. Details regarding the recruitment strategy for the online survey are described in detail in Janssen et al. (2014).

### 2.2. Procedure

Data for the study was collected online at four time points in 2010 and 2011 with six month intervals. At T1, directly after registration, the study website clarified that participation was volitional and that students could cease their participation at any point. Prior to the start of the study, parents of the candidate participants received a letter including a passive parental consent form. This form indicated that parents could object to participation by their child, which 37 parents did. The study protocol was approved by the Ethical Committee of the University of Amsterdam. All assessments were conducted online and participants were free to perform the assessments at their location of choice. Each successfully completed assessment was rewarded with a 5 EUR gift voucher.

### 2.3. Measures

#### 2.3.1. Weekly alcohol use

At each time point, we measured alcohol use with a self-report scale where participants indicated the average number of alcohol units consumed on each weekday (Wiers, Hoogveen, Sergeant & Gunning, 1997), based on the Time-Line Follow Back method (Sobell & Sobell, 1992). Participants were informed that a single Dutch alcohol unit contains 10 g or 12.7 ml of alcohol.

#### 2.3.2. Self-reported impulsivity

We measured two self-report aspects of impulsivity, Sensation Seeking and Impulsivity, using the Substance Use Risk Profile Scale (Woicik, Stewart, Pihl & Conrod, 2009), which consists of 23 items assessing participants' scores on personality traits associated with alcohol use. Impulsivity in this questionnaire is represented as the inability to inhibit rash action, whereas Sensation Seeking is represented as the desire for intense and rewarding experiences. Items in the SURPS took the form of statements (e.g. "I tend not to think before speaking"), about which participants were asked to indicate if they strongly disagreed, disagreed, agreed or strongly agreed on a four-point Likert scale. Cronbach's Alphas for reliability of the Sensation Seeking and Impulsivity scale were .70 and .61 respectively, which matches earlier studies (Woicik, Stewart, Pihl and Conrod, 2009).

#### 2.3.3. Behavioral measures

All behavioral measures were programmed in ActionScript 3.0 and displayed in browser using Adobe Flash, with window size 1000 × 600, and measured at each time point.

**2.3.3.1. Stimulus Response Compatibility (SRC; De Houwer, Crombez, Baeyens & Hermans, 2001).** We assessed approach bias with an SRC task. In this task, a manikin is presented below or above a stimulus. Stimuli are images of either alcoholic drinks or water. The task consisted of two blocks, each preceded by 8 practice trials. One block requested

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