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ORIGINAL ARTICLE

The relationship between drinking motives and interpretation bias in problematic drinkers with mild to borderline intellectual disability

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ABSTRACT

Background The goal of this study was to examine the relationship between drinking motives and interpretation bias (interpreting ambiguous stimuli in an alcohol-related way) in problematic drinkers with and without mild to borderline intellectual disability (MBID).

Method Participants ($N = 178$) were divided into 4 groups based on severity of alcohol use–related problems and full-scale IQ. They completed a word-association task and the Drinking Motives Questionnaire Revised (DMQ-R).

Results Problematic drinkers showed an interpretation bias towards alcohol. Participants with MBID had a relatively strong interpretation bias. The DMQ-R coping motive predicted the strength of the bias in negative scenarios, whereas the DMQ-R coping and social motives predicted the strength of the bias in positive scenarios.

Conclusions The activation of this bias might depend on individual differences in drinking motives, which provides implications for the assessment and treatment of problematic alcohol use in individuals with and without MBID.

KEYWORDS

addiction; alcohol; interpretation bias; drinking motives; mild intellectual disability

Introduction

Problematic alcohol use and alcohol use disorders are highly prevalent among the adult population. National data from the United States and studies among European countries indicate that around 6–12% of the adult population can be diagnosed with an alcohol use disorder (Merikangas & McClair, 2012; Rehm, Room, van den Brink, & Jacobi, 2005). According to the *Diagnostic and Statistical Manual of Mental Disorders* (5th ed.; *DSM-5*; American Psychiatric Association, 2013), problematic alcohol use is characterised by the persistent desire to drink alcohol and the inability to cut down or control drinking, despite the adverse physical, psychological, social, and interpersonal problems related to alcohol use. The complex and multifaceted nature of problematic alcohol use is reflected in the biopsychosocial model, which emphasises the interplay between biological, psychological, and social factors that interact with and influence each other (Donovan, 2005). One of the factors contributing to the development and maintenance of problematic alcohol use is the effect alcohol use has on the brain, including disruptions in the information processing and reward centre of the brain (Koob, 2013; Volkow, Wang, Tomasi, & Baler, 2013). Among others, this can result in a pattern of selective information processing, including biases in association and interpretation (Stacy & Wiers, 2010).

The interpretation or association bias can be described as a tendency to interpret ambiguous cues in an alcohol-related way. That is, ambiguous cues often require interpretation, explanation, and evaluation. The word "draft," for example, could refer to a current of air, a preliminary version of something you wrote, or an alcoholic beverage drawn from a keg – depending on context and personal experiences and memories (Van Duijvenbode, Didden, Korzilius, & Engels, 2016). This bias is typically studied using indirect tasks, such as the implicit association task and word-association tasks (for an overview, see Reich, Below, & Goldman, 2010; Stacy, Ames, & Grenard, 2006). In the present study, the focus is on the latter, because word-association tasks have been found to be the strongest predictors of alcohol use compared to other indirect measures (Rooke, Hine, & Thorsteinsson, 2008; Thush et al., 2007). Word-association tasks require participants to generate their first, spontaneous response to ambiguous

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cues, such as words (e.g., "pitcher," "draft") or scenarios (e.g., "out with friends on a Friday night"). Using these tasks, problematic drinkers have consistently been found to interpret these cues in an alcohol-related way (e.g., Ames, Sussman, Dent, & Stacy, 2005; Krank, Schoenfeld, & Frigon, 2010; Woud, Fitzgerald, Wiers, Rinck, & Becker, 2012; Woud et al., 2014), which is indicative of an interpretation bias towards alcohol.

It seems plausible that the tendency to interpret environmental or situational cues in an alcohol-related way is not *always* present, but instead may be triggered by internal (e.g., mood, motives) and external (e.g., places, persons) contextual cues. For example, although the word "draft" could be interpreted in an alcohol-related way, this interpretation might be more readily available when one is out with friends on a Friday night than when one is working on a school assignment on Monday morning and has just finished the first complete version. Similarly, certain thoughts, feelings, emotions, or personal motives might also trigger alcohol-related associations and interpretations. Indeed, Krank and Wall (2006) theorise that the context may be an integral part of memory processing and thus be part of the individuals' alcohol-related memories and associations. Following this line of reasoning, two recent studies have focused on the relationship between the interpretation bias and drinking motives (Salemink & Wiers, 2014; Woud, Becker, Rinck, & Salemink, 2015). It was found that the level of coping drinking (i.e., drinking alcohol to cope with unpleasant emotions) predicted the strength of the interpretation bias in negative, stressful scenarios (e.g., feeling down or stressed). That is, by repeatedly drinking alcohol in response to negative situations, coping drinkers have formed an association between unpleasant emotions, alcohol use, and tension reduction ("When I feel down or stressed, I can drink alcohol to feel better again"). Thus, their alcohol-related memory schemata become activated when confronted with negative situations, leading to an interpretation bias. Similarly, Salemink and Wiers (2014) – but not Woud, Becker, et al. (2015) – found that enhancement drinkers (i.e., individuals who drink alcohol to enhance positive emotions) showed an interpretation bias in positive, enjoyable scenarios (i.e., a party, being out with friends).

The primary goal of this study was to examine the relationship between drinking motives and the interpretation bias in problematic drinkers with and without mild to borderline intellectual disability (MBID; IQ 50–85; American Psychiatric Association, 2013). Although the prevalence of alcohol use in individuals with MBID is generally lower compared to that in the general population (McGuire, Daly, & Smyth, 2007), they have been identified as a risk group for more severe negative consequences of alcohol use (e.g., health problems, social and interpersonal problems, and emotional and behavioural problems; Slayter, 2008) and for developing problematic alcohol use (Burgard, Donohue, Azrin, & Teichner, 2000; McGillicuddy, 2006). However, the current knowledge on substance use (disorder) in individuals with MBID is scarce and there is a need for valid screening and assessment tools and effective treatment interventions (Carroll Chapman & Wu, 2012; Kerr, Lawrence, Darbyshire, Middleton, & Fitzsimmons, 2013; Van Duijvenbode et al., 2015). Studying the interpretation bias in problematic drinkers with MBID would be interesting, because it could provide new ways for the assessment and treatment of problematic alcohol use. For example, word-association tasks provide indirect measures of high-risk situations for alcohol use or relapse (Woud et al., 2012) and could therefore be incorporated in relapse prevention strategies. In addition, preliminary evidence shows that the interpretation bias could be trained in cognitive bias modification procedures (Woud, Hutschemaekers, Rinck, & Becker, 2015). In such procedures, problematic drinkers are trained to interpret ambiguous alcohol-relevant scenarios in a neutral manner. Positive results for this type of training have also been found in anxiety (Beard, 2011), and it has been proven to be as effective as cognitive behavioural therapy in this field (Bowler et al., 2012).

Recently, an interpretation bias has also been found in a comparable, albeit different, sample of problematic drinkers with MBID (Van Duijvenbode, Didden, Korzilius, & Engels, 2016). Problematic drinkers with and without MBID were asked to finish 24 short scenarios with their first spontaneous response. The scenarios described positive, negative, and neutral scenarios, such as a party, having a fight with your best friend, and returning your new Xbox to the store because it doesn't work properly (Woud et al., 2012). Problematic drinkers gave significantly more alcohol-related answers than light drinkers, which is indicative of an interpretation bias towards alcohol. Surprisingly, results showed that the interpretation bias was stronger in participants with MBID compared to participants without MBID. Explanations for these results remain speculative.

In this paper, we therefore sought to replicate our previous findings and expand the findings of Salemink and Wiers (2014) and Woud, Becker, et al. (2015) on the relationship between the interpretation bias and drinking motives, and who have exclusively focused on samples of heavy drinking students. We explored the relationship between the interpretation bias and drinking motives in light of problematic drinkers with and without MBID. Our first hypothesis was that, compared to light drinkers, problematic drinkers would show an

interpretation bias towards alcohol and that the strength of this bias would be correlated with the severity of the alcohol use–related problems (see Stacy & Wiers, 2010). Considering that research on the interpretation bias in individuals with MBID is limited to our own previous study (Van Duijvenbode, Didden, Korzilius, & Engels, 2016), we conducted exploratory statistical analyses to study the role of full-scale IQ on the strength and manifestation of the interpretation bias but did not formulate any a priori hypotheses about this role. Our second hypothesis was that participants' drinking motives would predict the interpretation bias for positive and negative scenarios in the word-association task. More specifically, we hypothesised that enhancement motives would predict the bias for positive scenarios and that coping motives would predict the bias score for negative scenarios (Salemink & Wiers, 2014; Woud, Becker, et al., 2015).

Method

Design

In this study we used a cross-sectional design. We studied two groups comprising adults with and without MBID. In addition, each of these groups was further broken down based on the severity of alcohol use–related problems. We therefore studied four groups: light and problematic drinkers with and without MBID.

Participants

Participants were recruited via two routes. First, participants were recruited from organisations within ID care ($n = 47$, 26.4%) and addiction medicine ($n = 85$, 47.8%).

Table 1. Examples of the positive, negative, and neutral scenarios used (Woud et al., 2012) and possible answers given by participants, derived from Van Duijvenbode, Didden, Korzilius, and Engels (2016).

	Scenario	Possible answer
Positive scenario	**Movie night** Movie night at your friend's house. "One more?," one of your friends asks. You cannot resist temptation and reach for a …	New film (alcohol-unrelated) Glass (ambiguous) Beer (alcohol-related)
Negative scenario	**Bad day** It is a horrible day and nothing works. You want to lose this bad feeling and treat yourself. You get a strong craving for …	Chocolate (alcohol-unrelated) A drink (ambiguous) Alcohol (alcohol-related)
Neutral scenario	**Poker** You play poker with your friends every other week. Everything is ready and the cards have been dealt. This time, your cards are very …	Good (alcohol-unrelated) Bad (alcohol-unrelated) Difficult to win with (alcohol-unrelated)

Second, participants were recruited via advertisements on social media, the Radboud University, Nijmegen, the Netherlands, and word of mouth ($n = 46$, 25.8%). Exclusion criteria included being younger than 18 years old; currently experiencing withdrawal, psychotic, or depressive/manic symptoms (as assessed by the treatment team); and no access to alcohol in the last 1.5 months. Participants with a history of problematic alcohol use who were currently abstaining for longer than 1.5 months were also excluded from participating (i.e., only current drinkers were included in the study). A preliminary check was conducted to see if the participants matched the inclusion criteria.

A total of 178 participants (131 men, 73.6%) with a mean age of 42.3 years ($SD = 12.8$, range: 18–68 years) were included in the study. The majority of the participants ($n = 161$, 90.4%) originated from the Netherlands. The other participants originated from Morocco/Turkey ($n = 6$, 3.3%), Surinam/The Antilles ($n = 3$, 1.8%), or other Western and non-Western countries ($n = 8$, 4.5%). All participants spoke Dutch fluently. The educational background of participants differed markedly: 26 participants (14.6%) finished primary school, 38 participants (21.3%) finished special education, 32 participants (18.0%) finished secondary school, 41 participants (23.0%) finished vocational school, and 38 participants (21.3%) finished university (college). Three participants (1.7%) had no completed education and six participants (3.4%) still attended vocational school or university (college). More than half of the participants ($n = 102$, 57.3%) were diagnosed with one or more psychiatric disorders, as assessed by the treatment team. In addition to substance-use disorders ($n = 87$, 48.9%), anxiety disorders, autism spectrum disorder, and attention-deficit/hyperactivity disorder were diagnosed most often (all $n = 15$, 8.4%). Twenty-two participants (12.4%) were diagnosed with a personality disorder. Eighty participants (44.9%) were prescribed psychotropic medication, including benzodiazepines, antipsychotics, and antidepressants.

Measurements

Interpretation bias

The interpretation bias was measured using the open-ended, ambiguous scenarios developed by Woud et al. (2012). The scenarios were adapted to ensure feasibility in an adult, clinical sample of individuals with MBID (see Van Duijvenbode, Didden, Korzilius, & Engels, 2016). The task consisted of 24 scenarios (eight positive, six negative, and 10 neutral) of a title and three lines, of which the last sentence ended abruptly (see Table 1).

To control for carry-over effects, we used three different booklets with a different order of scenarios. The order of the booklets was balanced for time by a Latin square across participants (Keedwell & Dénes, 2015).[1] All scenarios were read aloud to the participants and all answers were written down verbatim by the researcher. Participants were asked to finish each scenario with their first spontaneous response. They were assured there were no correct or incorrect answers. There was no time limit for the administration of the task. In line with Woud et al. (2014), the answers were then coded as binary variables (alcohol-related or unrelated/ambiguous) by two independent raters using a conservative rating system. Consensus scores agreed upon by both raters were used to calculate mean bias scores (i.e., total score, positive scenario score, negative scenario score) for each participant. Total bias scores ranged from 0 to 24; the bias scores for positive and negative scenarios had a maximum of 8 and 6, respectively. The interrater reliability was excellent, with Cohen's kappa = .99, $p < .001$, and percentages of agreement between the two raters ranging from 95.8% to 100%. The internal consistency of the bias scores ranged from poor for the bias score for positive scenarios (Cronbach's alpha = .46, *M* inter-item correlation = .11) to questionable for the bias scores for neutral (Cronbach's alpha = .61, *M* inter-item correlation = .46) and negative scenarios (Cronbach's alpha = .69, *M* inter-item correlation = .28).

Substance use

Participants' general frequency and quantity of alcohol use was assessed with the Substance Use and Misuse in Intellectual Disability Questionnaire (SumID-Q; VanDerNagel, Kiewik, van Dijk, De Jong, & Didden, 2011; see also VanDerNagel et al., 2016) and converted into standard units of 10 g of alcohol to generate a measure of the weekly alcohol consumption by participants (International Center for Alcohol Policies, 2010). The severity of alcohol use–related problems was measured with the Alcohol Use Disorder Identification Test (AUDIT; Babor, Higgins-Biddle, Saunders, & Monteiro, 2001; Dutch translation: Schippers & Broekman, 2010). The AUDIT is a 10-item questionnaire about the amount, frequency, and consequences of alcohol use, with total scores ranging from 0 to 40. A score of 8 or more indicates hazardous alcohol use (Babor et al., 2001) and was used in this study to classify participants as either light drinkers (score < 8) or problematic drinkers (score ≥ 8). The internal consistency of the AUDIT in the current study was good (Cronbach's alpha = .91, *M* inter-item correlation = .50).

Drinking motives

Drinking motives were assessed with the Drinking Motives Questionnaire Revised (Cooper, 1994). The DMQ-R is a 20-item questionnaire in which participants indicate the relative frequency of drinking for each of the four drinking motives (i.e., enhancement, coping, social, and conformity motives). Each drinking motive is assessed with five questions (e.g., "I drink to forget my worries" or "I drink because it gives me a pleasant feeling"). The questionnaire was adapted to accommodate the population of individuals with MBID. Following the suggestions made by Hartley and MacLean (2006) and Finlay and Lyons (2001), a 4-point scale ranging from 0 (*almost never*) to 3 (*almost always*) was used rather than the original 5-point scale to help participants with MBID differentiate between the options. Total scores therefore ranged from 0 to 15 for each of the four drinking motives. In addition, Figure 1 shows the visual aid of the options that was included to further help decision-making (Bailey, Willner, & Dymond, 2011). The internal consistency of the DMQ-R in the current study was good, with a Cronbach's alpha of .89 (*M* inter-item correlation = .28) for the total scale and Cronbach's alphas of .82 for the Social subscale, .92 for the Coping subscale, .70 for the Enhancement subscale, and .78 for the Conformity subscale.

IQ

IQ was measured using the most recent scores on the Dutch version of the Wechsler Adult Intelligence Scale – Third Edition (WAIS-III-NL; Uterwijk, 2000) in the participants' files. If unavailable, a tetrad short form of the WAIS-III was administered ($n = 122$, 68.5%) consisting of two subtests for verbal IQ (Vocabulary and Similarities) and two subtests for performance IQ (Block Design and Matrix Reasoning). This test is administered in approximately 30 minutes and provides a reliable and valid estimate of full-scale IQ in individuals with MBID (Van Duijvenbode, Didden, van den Hazel, & Engels, 2016). Estimated full-scale IQ was used to identify participants with MBID (IQ < 85) or without MBID (IQ ≥ 85).

Procedure

All participants provided written informed consent. The study consisted of one session of 1 to 1.5 hours each. During this session, participants first provided general demographic information. If necessary, the tetrad WAIS-III short form was administered to estimate full-scale IQ. Participants then completed the scenario task, after which substance use and drinking motives were assessed with the DMQ-R. Finally, participants were

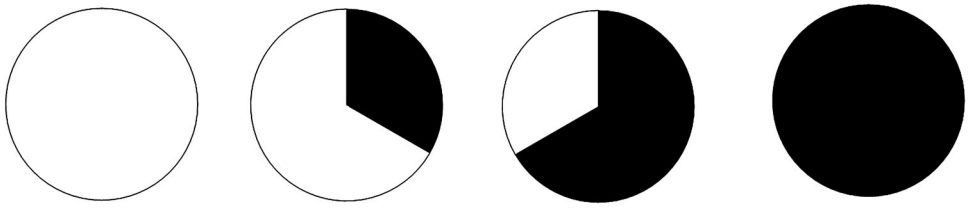

Figure 1. The visual aid that was used in the Drinking Motives Questionnaire Revised (Cooper, 1994) to indicate the frequency (from left to right: never, sometimes, most of the time, almost always) with which participants drank alcohol for a particular reason.

thanked for their time and received a gift worth €5.00 (US$6.50, GBP£3.70) for their participation. The study was approved by the Ethics Committee of the Faculty of Social Sciences, Radboud University, Nijmegen, the Netherlands (ECG2012-1301-003).

Statistical analyses

All data were analysed using IBM SPSS Statistics (Version 20). A one-way ANOVA and chi-square analyses were conducted to compare demographic variables between the groups. To test our first hypothesis that problematic drinkers would show an interpretation bias towards alcohol, we calculated Pearson product–moment correlation coefficients between the severity of alcohol use–related problems (AUDIT score) and the bias scores. The bias scores were further investigated using one-sample *t* tests to compare the mean bias scores to zero and independent samples *t* tests to explore the differences between the two groups (light and problematic drinkers) in the strength of the bias. To also investigate the role of IQ, we conducted a 2×2 factorial ANOVA with severity of alcohol use–related problems (AUDIT score) and level of intellectual functioning (estimated full-scale IQ) as between-group factors. The second hypothesis regarding the relationship between the interpretation bias and participants' drinking motives was analysed using a Pearson product–moment correlation analysis and linear regression analyses. All variables were standardised using *z* scores before they were entered into the regression (see Woud, Becker, et al., 2015). The bias scores for positive and negative scenarios were used as outcome variables in the regression analyses. The four drinking motives (i.e., enhancement, coping, social, and conformity motives) were entered as predictor variables. None of the variables violated the assumption of normality. A post-hoc power analysis (with G*Power Version 3.1.92) showed that, with the number of participants in the sample and the statistical tests used, a power of .99 was achieved at a medium effect size ($f = .25$) and α of .05. An overview of the constructs, measures, hypotheses, and results of the study is presented in Table 4.

Results

Group characteristics

Four groups were created based on the severity of alcohol use–related problems (AUDIT score) and intellectual functioning (estimated full-scale IQ): light drinkers without MBID ($n = 40$), problematic drinkers without MBID ($n = 43$), light drinkers with MBID ($n = 41$), and problematic drinkers with MBID ($n = 54$). A one-way ANOVA with a post-hoc Tukey HSD test was conducted to compare demographic variables between the four groups (see Table 2).

With the exception of the expected differences in alcohol use and alcohol use–related problems, light and problematic drinkers did not differ significantly in demographic variables. Similarly, with the exception of estimated full-scale, verbal, and performance IQ, all demographic variables were identical between participants with and without MBID. A chi-square analysis showed that the groups also differed on gender ratio, $\chi^2(3) = 8.78$, $p = .032$, with relatively few female problematic drinkers ($n = 18$, 10.1%; see note 1). This was to be expected considering the gender differences in the prevalence of alcohol use (disorders; Lev-Ran, Le Strat, Imtiaz, Rehm, & Le Foll, 2013; Seedat et al., 2009). There were no differences on age and ethnic origin (*p*s > .05).

Interpretation bias

To test our first hypothesis that problematic drinkers would show an interpretation bias towards alcohol, we first calculated Pearson product–moment correlation coefficients between the severity of alcohol use–related problems (AUDIT score) and the bias scores. As shown in Table 3, the severity of alcohol use–related problems correlated weakly to moderately with the total bias score ($r = .39$, $p < .001$), the bias score for positive scenarios ($r = .15$, $p = .043$), and the bias score for negative scenarios ($r = .48$, $p < .001$). A Fisher *r*-to-*z*-transformation indicated that the bias score for negative scenarios correlated significantly stronger with the severity of alcohol use–related problems than the bias score for positive

Table 2. Participant characteristics per group ($N = 178$): light drinkers without mild to borderline intellectual disability (MBID; $n = 40$), problematic drinkers without MBID ($n = 43$), light drinkers with MBID ($n = 41$), and problematic drinkers with MBID ($n = 54$).

		Without MBID		With MBID				
	Range	Light drinkers *M* (*SD*)	Problematic drinkers *M* (*SD*)	Light drinkers *M* (*SD*)	Problematic drinkers *M* (*SD*)	*F* (3, 174)	*p*	η_p^2
Age	18–68	41.50 (11.68)	46.53 (12.53)	39.68 (12.78)	41.48 (13.32)	2.32	.077	.04
Estimated full-scale IQ	45–115	103.18 (7.61)	92.88 (6.53)	67.05 (10.63)	75.00 (6.87)	177.11	< .001	.76
Estimated verbal IQ	48–118	98.71 (10.04)	94.90 (7.45)	67.59 (11.31)	74.58 (9.57)	100.85	< .001	.65
Estimated performance IQ	41–101	107.60 (9.23)	90.28 (10.26)	69.95 (12.29)	76.85 (7.90)	114.98	< .001	.68
AUDIT score[a]	0–37	4.88 (1.96)	22.74 (7.38)	3.51 (2.09)	22.44 (6.87)	169.86	< .001	.75
Weekly alcohol consumption[b]	0–490	4.13 (3.53)	123.05 (92.22)	3.85 (5.11)	119.96 (83.21)	48.60	< .001	.46

Note. AUDIT = Alcohol Use Disorders Identification Test (Babor et al., 2001); η_p^2 = partial eta squared.
[a]Higher scores reflect more severe alcohol use–related problems (Babor et al., 2001).
[b]Weekly alcohol consumption was measured in standard units of 10 g alcohol (International Center for Alcohol Policies, 2010).

scenarios (z difference = −3.48, $p < .001$). The severity of alcohol use–related problems did not correlate significantly with the neutral bias score ($r = .09$, $p = .23$). Estimated full-scale IQ correlated weakly with the neutral bias score ($r = -.20$, $p = .009$), indicating that participants with a lower estimated full-scale IQ gave more alcohol-related answers to neutral scenarios. Estimated full-scale IQ did not correlate significantly with the other bias scores ($ps > .05$).

Second, we conducted one-sample t tests to compare the mean bias scores to zero, meaning no bias. Mean bias scores for positive and negative scenarios are presented in Figure 2. Both light and problematic drinkers showed significant interpretation biases towards alcohol ($ps < .001$). An independent samples t test indicated that the total bias score, $t(176) = 5.59$, $p < .001$, Cohen's $d = 0.84$, and the bias score for negative scenarios, $t(176) = 7.38$, $p < .001$, Cohen's $d = 1.11$, but not the bias score for positive scenarios, $t(176) = 1.89$, $p = .061$, Cohen's $d = 0.28$, differed significantly between light and problematic drinkers. Light and problematic drinkers did not show a significant bias score towards alcohol on neutral scenarios ($ps > .05$), nor did the bias score for neutral scenarios differ significantly between the two groups, $t(176) = 1.76$, $p = .08$, Cohen's $d = 0.27$.

The role of the severity of alcohol use–related problems and estimated full-scale IQ in the (strength of the) interpretation bias was further investigated using a 2 × 2 factorial ANOVA. Main effects for severity of alcohol use–related problems and IQ as well as the interaction effects for the total bias scores and the bias scores for positive and negative scenarios were investigated. There were significant interaction effects between severity of alcohol use–related problems and IQ for the total bias score, $F(1, 174) = 6.78$, $p = .010$, $\eta_p^2 = .04$, and the bias score for positive scenarios, $F(1, 174) = 6.59$, $p = .011$, $\eta_p^2 = .04$. On both variables, problematic drinkers showed a stronger interpretation bias compared to light drinkers, with problematic drinkers with MBID showing particularly strong biases. In addition, the main effect for severity of alcohol use–related problems reached statistical significance for bias scores for negative scenarios, $F(1, 174) = 52.51$, $p < .001$, $\eta_p^2 = .23$, with problematic drinkers showing stronger bias scores than light drinkers. All other main and interaction effects were not significant ($ps > .05$). These results remained when

Table 3. Correlation matrix for indices of IQ severity of alcohol use–related problems (AUDIT score and weekly alcohol consumption), IQ (estimated full-scale, verbal, and performance IQ), the interpretation bias, and drinking motives.

		1	2	3	4	5	6	7	8	9	10	11	12	13
1	AUDIT score	–												
2	Weekly alcohol consumption	.79**	–											
3	Estimated full-scale IQ	−.03	−.05	–										
4	Estimated verbal IQ	.06	.04	.92**	–									
5	Estimated performance IQ	−.15	−.16*	.92**	.71**	–								
6	Total bias score	.39**	.32**	−.03	−.00	−.00	–							
7	Positive bias score	.15*	.10	.04	.04	.11	.82**	–						
8	Negative bias score	.48**	.41**	−.04	.01	−.07	.87**	.45**	–					
9	Neutral bias score	.09	.10	−.20**	−.24**	−.16*	.22**	.09	.10	–				
10	DMQ-R enhancement	.56**	.47**	−.03	−.00	−.11	.40**	.25**	.42*	.10	–			
11	DMQ-R coping	.81**	.64**	−.08	−.01	−.18*	.39**	.17*	.49**	.00	.65**	–		
12	DMQ-R social	.26**	.21**	.10	.07	.07	.34**	.27**	.31**	.04	.54**	.30**	–	
13	DMQ-R conformity	.11	.15	−.06	−.04	−.06	.12	.10	.10	−.02	.33**	.27**	.43**	–

Note. AUDIT = Alcohol Use Disorders Identification Test (Babor et al., 2001); DMQ-R = Drinking Motives Questionnaire Revised (Cooper, 1994).
*$p < .05$.
**$p < .01$.

Table 4. Narrative description of the constructs, measures, hypotheses, and results of the study.

Construct	Measure	Hypothesis	Result
Interpretation bias	Word-association task (24 positive, negative, and neutral scenarios), adapted from Woud et al. (2012)	(1) Problematic drinkers show an interpretation bias towards alcohol (2) The strength of the bias correlates significantly with the severity of alcohol use–related problems	(1) Hypothesis is confirmed. Problematic drinkers gave significantly more alcohol-related answers than light drinkers. (2) Hypothesis is confirmed. The strength of the bias correlated significantly with the severity of alcohol use–related problems.
IQ	Wechsler Adult Intelligence Scale – Third Edition (Uterwijk, 2000)	No a priori hypotheses (exploratory analyses)	Interaction effect between est. full-scale IQ and the total bias score; interaction effect between est. full-scale IQ and the bias score for positive scenarios; weak correlation between estimated full-scale IQ and the bias score for neutral scenarios.
Drinking motives	Drinking Motives Questionnaire Revised (subscales: enhancement, coping, social, and conformity motives; Cooper, 1994)	(1) Enhancement motives predict the bias for positive scenarios (2) Coping motives predict the bias for negative scenarios	(1) Hypothesis not confirmed. Social drinking motives predicted the bias for positive scenarios. (2) Hypothesis partly confirmed. Social and coping drinking motives predicted the bias for negative scenarios.

controlling for (estimated) verbal IQ and the neutral bias score in an ANCOVA.

Relationship between interpretation bias and drinking motives

To test our second hypothesis regarding the relationship between the interpretation bias and participants' drinking motives, we first calculated Pearson product–moment correlation coefficients. As shown in Table 3, both the total bias score and the bias scores for positive and negative scenarios separately correlated weakly to moderately – yet significantly – with enhancement, coping, and social drinking motives. Conformity drinking motives were not correlated significantly with the bias scores. The bias score for neutral scenarios did not correlate with any of the four drinking motives. When controlling for AUDIT score in a partial correlation analysis, the correlation between the bias scores and the coping drinking motive disappeared. All other significant results remained.

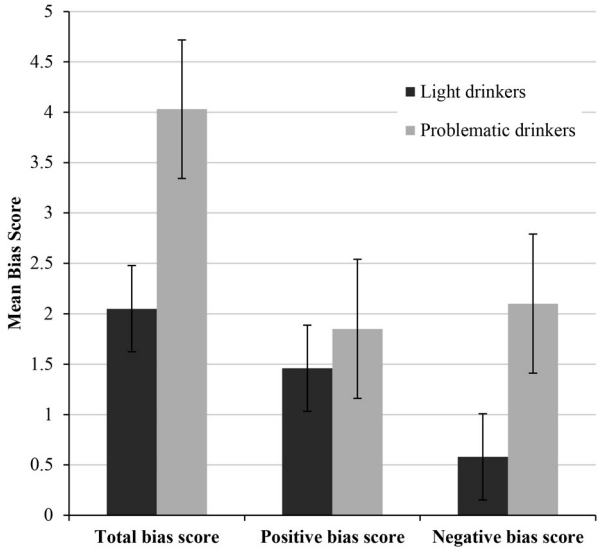

Figure 2. Mean and standard error of the total bias scores and bias scores for positive and negative scenarios separately for light drinkers ($n = 81$) and problematic drinkers ($n = 97$).

These results were supplemented with linear regression analyses to assess the predictive value of drinking motives for the bias scores for positive and negative situations. When predicting the bias scores for positive situations, the full model was statistically significant, $F(4, 173) = 4.33$, $p = .002$, and explained 30.2% of the variance. The DMQ-R social motive was the only significant predictor ($\beta = .22$, $SE = .09$, $p = .019$). None of the other DMQ-R drinking motives predicted the bias score for positive scenarios significantly (βs ranging from .00 to .13).

The model for the bias scores for negative scenarios also reached statistical significance, $F(4, 173) = 16.79$, $p < .001$, and explained 52.9% of the variance. Both the DMQ-R social motive ($\beta = .18$, $SE = .08$, $p = .030$) and coping motive ($\beta = 0.38$, $SE = .08$, $p < .001$) significantly predicted the bias score for negative scenarios. The other two drinking motives (i.e., enhancement and conformity) did not significantly predict the bias score for negative scenarios ($\beta = .11$, $SE = .10$, $p = .277$; $\beta = .–11$, $SE = .07$, $p = .135$; respectively).

Discussion

Problematic alcohol use has repeatedly been associated with cognitive biases in information processing, including an interpretation bias or a tendency to interpret ambiguous, alcohol-relevant cues in an alcohol-related way. Considering the influence of contextual cues (e.g., cognitive, social, and affective states) on memories, associations, and interpretations (Krank & Wall, 2006),

the goal of the present study was to explore the relationship between the interpretation bias and drinking motives in problematic drinkers with and without MBID. An overview of the constructs, measures, hypotheses, and results of the study is presented in Table 4.

Our first hypothesis was that problematic drinkers with and without MBID would show an interpretation bias towards alcohol. The results supported this hypothesis. Problematic drinkers had a tendency to interpret ambiguous, alcohol-relevant cues in an alcohol-related way, and the strength of this bias correlated significantly, albeit weakly to moderately, with the severity of alcohol use–related problems. Similar results have consistently been found in previous studies using word-association paradigms (e.g., Ames et al., 2005; Krank et al., 2010; Woud et al., 2012, 2014), including in our previous study using a comparable sample of problematic drinkers with and without MBID (Van Duijvenbode, Didden, Korzilius, & Engels, 2016). Two of our results stand out. First, although problematic drinkers showed an interpretation bias in both positive and negative scenarios, the bias was especially strong in negative scenarios. Although this is consistent with the literature on drinking motives in clinical samples (e.g., Carpenter & Hasin, 1999; Mezquita et al., 2011) showing problematic drinkers often drink alcohol to cope with unpleasant emotions such as stress, anxiety, and depression, this explanation remains speculative because enhancement motives have also frequently been found among problematic drinkers (e.g., Cadigan, Martens, & Herman, 2015). Second, in line with our previous study (Van Duijvenbode, Didden, Korzilius, & Engels, 2016) we found the total bias score to be particularly high in problematic drinkers with MBID. These results remained when controlling for (estimated) verbal IQ, suggesting that verbal capacity does not play a role in the assessment of the interpretation bias. One possible explanation for our results is the increased vulnerability to probing questions or a tendency to please others – as a result of which they could have responded in accordance with the research goals more often than individuals without MBID (Finlay & Lyons, 2001, 2002). Another possible consideration is that the alcohol construct was more accessible to participants with MBID than to participants without MBID, because estimated full-scale IQ correlated negatively with the bias score for neutral scenarios. However, both explanations remain speculative and need to be further studied in future research.

Our second hypothesis was that the interpretation bias for positive and negative scenarios would be related to participants' drinking motives. More specifically, we expected that the bias score for positive, enjoyable scenarios would be related to enhancement motives and the bias score for negative, stressful scenarios to be related to coping motives (Salemink & Wiers, 2014; Woud, Becker, et al., 2015). Our results partially support this hypothesis. In line with our expectations, we found that coping motives predicted the strength of the interpretation bias in negative scenarios. These results indicate that coping drinkers have formed a strong associative relationship between unpleasant emotions, alcohol use, and tension reduction by repeatedly drinking alcohol in response to experiencing unpleasant emotions or negative situations. Hence, when confronted with such negative situations, their alcohol-related memory schemata become activated, increasing the chances of alcohol use in these situations. In contrast with our expectations, however, positive situations *also* activated alcohol-related schemata in coping drinkers. Steward, Hall, Wilkie, and Birch (2002) and Birch et al. (2004) found similar results and concluded that both positive and negative scenarios activate the alcohol network of coping drinkers, perhaps because they associate alcohol use both with reducing unpleasant emotions as well as with enhancing pleasant emotions. Indeed, in two studies with college students, both Littlefield, Vergés, Rosinski, Steinley, and Sher (2013) and Cadigan et al. (2015) found that coping and enhancement drinkers do not form two distinct groups, but rather often drink for both enhancement and coping motives combined. This would explain why coping drinkers show an interpretation bias to both positive and negative scenarios. Also contrary to expectations, we found that social motives but not enhancement motives predicted the strength of the interpretation bias in positive scenarios. This means that individuals who drink alcohol to facilitate or improve social relationships or to enhance enjoyment in social situations tend to interpret positive scenarios with alcohol use. We offer two possible explanations. First, research among adolescents has concluded that there is considerable overlap between the enhancement and social drinking motives (e.g., Read, Wood, Kahler, Maddock, & Palfai, 2003; Steinhausen & Metzke, 2003). Second, and related, our results could be explained by the nature of the scenarios in the word-association task. As the positive scenarios mostly describe pleasant situations with others (e.g., a party, being with friends), these scenarios likely tap into social drinking motives more than into enhancement motives (see Woud, Becker, et al., 2015).

We note several limitations to the current study. First, participants were aware that they were participating in a study on alcohol use. This could have biased their response, for example, by censoring their responses in line or in contrast with the research goals. As described earlier and as suggested in our

previous study (Van Duijvenbode, Didden, Korzilius, & Engels, 2016), this could explain the stronger interpretation bias found in individuals with MBID and should be taken into account in future research on this topic. Second, the questionnaires used to measure the severity of alcohol use–related problems (AUDIT; Babor et al., 2001) and drinking motives (DMQ-R; Cooper, 1994) have not been validated for individuals with MBID. Because questions that require a judgement of frequency or amount and questions about general behavioural patterns have been proven to be difficult in individuals with MBID (Finlay & Lyons, 2001), the reliability and validity of the questionnaires and the cut-off scores of the AUDIT can be questioned despite the adaptations we have made to increase feasibility. Although the reliability of the AUDIT and DMQ-R were moderate to good in the current study, research could be directed at further validating these questionnaires for individuals with MBID. Third, the internal consistency of the bias scores was poor to questionable. Although this seems problematic, one of the strengths of the word-association tasks is that it allows for individual differences in the associative network (Woud et al., 2012). This means that while some scenarios might be associated with alcohol use, others might not – depending on contextual cues and personal memories. This then might explain the internal consistency scores of the bias scores. However, as previous studies using similar tasks have not reported internal consistency scores, this could be addressed in future research on the topic. Fourth, we used a cross-sectional design to study the relationship between the interpretation bias and drinking motives in problematic drinkers with and without MBID. This does neither allow us to draw conclusions about causality, nor does it provide insight into the role of the interpretation bias and drinking motives in the development and maintenance of problematic alcohol use. Future research should therefore use a prospective design to study the causal relationship between the interpretation bias, drinking motives, and severity of alcohol use–related problems. This would not only identify the factors related to the development of the interpretation bias, but would also enhance our understanding of the role of the interpretation bias in the development and maintenance of problematic alcohol use in general. Last, we solely focused on drinking motives in relation to the interpretation bias. Previous research suggests, however, that other contextual cues, such as mood and alcohol expectancies, can also influence the memory, associations, and interpretations (Krank & Wall, 2006). Similarly, it would be interesting to study potential cultural issues in the interpretation bias. For example, there is cross-cultural variation in beliefs, expectancies, and social norms of alcohol (Castro, Barrera, Mena, & Aguirre, 2014), which could subsequently be reflected in the results of studies on interpretation bias. Unfortunately, we were not able to do this due to a small number of cultural backgrounds (other than Dutch) in the current study. Future studies could therefore be directed at expanding our results by also taking these constructs into account and further disentangling the circumstances that trigger the activation of the interpretation bias in problematic drinkers.

To conclude, this study adds to the knowledge base on the underlying mechanisms of problematic alcohol use. More specifically, the results indicate that problematic drinkers with and without MBID tend to interpret ambiguous, alcohol-relevant situations in an alcohol-related way, but that the activation of this interpretation bias might depend on individual differences. This implies that treatment procedures should be tailored to personal drinking motives and alcohol-related associations. Word-association tasks, such as the one adopted in the current study, could be used to identify potential high-risk situations for alcohol use and relapse and could provide a novel way of treating problematic alcohol use by way of an interpretation retraining procedure (see Kelly, Masterman, & Marlatt, 2005). Woud, Hutschemaekers, et al. (2015) have found preliminary evidence for the feasibility of this kind of cognitive bias modification procedures, in which problematic drinkers are trained to interpret ambiguous alcohol-relevant scenarios in a neutral manner (but, for critique on cognitive bias modification procedures in the field of problematic alcohol use, see also Christiansen, Schoenmakers, & Field, 2015; Field, Marhe, & Franken, 2013). Our results therefore provide a new line of inquiry to improve the assessment and treatment of problematic alcohol use in individuals with and without MBID.

Note

1. We controlled for booklet number and gender in all analyses, but they had no effect. Therefore, only the results without booklet number and gender as a controlling variable are reported.

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References

American Psychiatric Association. (2013). *Diagnostic and statistical manual of mental disorders* (5th ed.). Arlington, VA: American Psychiatric Publishing.

Ames, S. L., Sussman, S., Dent, C. W., & Stacy, A. W. (2005). Implicit cognition and dissociative experiences as predictors of adolescent substance use. *The American Journal of Drug and Alcohol Abuse*, *31*, 129–162. doi:10.1081/ADA-200047908

Babor, T. F., Higgins-Biddle, J. C., Saunders, J. B., & Monteiro, M. G. (2001). *AUDIT. The Alcohol Use Disorders Identification Test: Guidelines for use in primary care* (2nd ed.). Geneva, Switzerland: World Health Organization.

Bailey, R., Willner, P., & Dymond, S. (2011). A visual aid to decision-making for people with intellectual disabilities. *Research in Developmental Disabilities*, *32*, 37–46. doi:10.1016/j.ridd.2010.08.008

Beard, C. (2011). Cognitive bias modification for anxiety: Current evidence and future directions. *Expert Review of Neurotherapeutics*, *11*, 299–311. doi:10.1586/ern.10.194

Birch, C. D., Stewart, S. H., Wall, A.-M., McKee, S. A., Eisnor, S. J., & Theakston, J. A. (2004). Mood-induced increases in alcohol expectancy strength in internally motivated drinkers. *Psychology of Addictive Behaviors*, *18*, 231–238. doi:10.1037/0893-164X.18.3.231

Bowler, J. O., Mackintosh, B., Dunn, B. D., Mathews, A., Dalgleish, T., & Hoppitt, L. (2012). A comparison of cognitive bias modification for interpretation and computerized cognitive behavior therapy: Effects on anxiety, depression, attentional control, and interpretive bias. *Journal of Consulting and Clinical Psychology*, *80*, 1021–1033. doi:10.1037/a0029932

Burgard, J. F., Donohue, B., Azrin, N. H., & Teichner, G. (2000). Prevalence and treatment of substance abuse in the mentally retarded population: An empirical review. *Journal of Psychoactive Drugs*, *32*, 293–298. doi:10.1080/02791072.2000.10400452

Cadigan, J. M., Martens, M. P., & Herman, K. C. (2015). A latent profile analysis of drinking motives among heavy drinking college students. *Addictive Behaviors*, *51*, 100–105. doi:10.1016/j.addbeh.2015.07.029

Carpenter, K. M., & Hasin, D. S. (1999). Drinking to cope with negative affect and DSM-IV alcohol use disorders: A test of three alternative explanations. *Journal of Studies on Alcohol*, *60*, 694–704. doi:10.15288/jsa.1999.60.694

Carroll Chapman, S. L., & Wu, L.-T. (2012). Substance abuse among individuals with intellectual disabilities. *Research in Developmental Disabilities*, *33*, 1147–1156. doi:10.1016/j.ridd.2012.02.009

Castro, F. G., Barrera, M., Mena, L. A., & Aguirre, K. M. (2014). Culture and alcohol use: Historical and sociocultural themes from 75 years of alcohol research. *Journal of Studies on Alcohol and Drugs*, *17*, 36–49. doi:10.15288/jsads.2014.s17.36

Christiansen, P., Schoenmakers, T. M., & Field, M. (2015). Less than meets the eye: Reappraising the clinical relevance of attentional bias in addiction. *Addictive Behaviors*, *44*, 43–50. doi:10.1016/j.addbeh.2014.10.005

Cooper, M. L. (1994). Motivations for alcohol use among adolescents: Development and validation of a four-factor model. *Psychological Assessment*, *6*, 117–128. doi:10.1037/1040-3590.6.2.117

Donovan, D. M. (2005). Assessment of addictive behaviors for relapse prevention. In D. M. Donovan & G. A. Marlatt (Eds.), *Assessment of addictive behaviors* (2nd ed., pp. 1–48). New York, NY: The Guilford Press.

van Duijvenbode, N., VanDerNagel, J. E. L., Didden, R., Engels, R. C. M. E., Buitelaar, J. K., Kiewik, M., & de Jong, C. A. J. (2015). Substance use disorders in individuals with mild to borderline intellectual disability: Current status and future directions. *Research in Developmental Disabilities*, 38, 319–328. doi:10.1016/j.ridd.2014.12.029

Field, M., Marhe, R., & Franken, I. H. A. (2013). The clinical relevance of attentional bias in substance use disorders. *CNS Spectrums*, 1–6.

Finlay, W. M. L., & Lyons, E. (2001). Methodological issues in interviewing and using self-report questionnaires with people with mental retardation. *Psychological Assessment*, *13*, 319–335. doi:10.1037/1040-3590.13.3.319

Finlay, W. M. L., & Lyons, E. (2002). Acquiescence in interviews with people who have mental retardation. *Mental Retardation*, *40*, 14–29. doi:10.1352/0047-6765(2002)040<0014:AIIWPW>2.0.CO;2

Hartley, S. L., & MacLean, W. E., Jr. (2006). A review of the reliability and validity of Likert-type scales for people with intellectual disability. *Journal of Intellectual Disability Research*, *50*, 813–827. doi:10.1111/j.1365-2788.2006.00844.x

International Center for Alcohol Policies. (2010). International drinking guidelines. Retrieved from http://www.icap.org/table/Internationaldrinkingguidelines

Keedwell, D., & Dénes, J. (2015). *Latin squares and their applications* (2nd ed.). Amsterdam, the Netherlands: Elsevier.

Kelly, A. B., Masterman, P. W., & Marlatt, G. A. (2005). Alcohol-related associative strength and drinking behaviours: Concurrent and prospective relationships. *Drug and Alcohol Review*, *24*, 489–498. doi:10.1080/09595230500337675

Kerr, S., Lawrence, M., Darbyshire, C., Middleton, A. R., & Fitzsimmons, L. (2013). Tobacco and alcohol-related interventions for people with mild/moderate intellectual disabilities: A systematic review of the literature. *Journal of Intellectual Disability Research*, *57*, 393–408. doi:10.1111/j.1365-2788.2012.01543.x

Koob, G. F. (2013). Addiction is a reward deficit and stress surfeit disorder. *Frontiers in Psychiatry*, *4*, 1–18. doi:10.3389/fpsyt.2013.00072

Krank, M. D., Schoenfeld, T., & Frigon, A. P. (2010). Self-coded indirect memory associations and alcohol and marijuana use in college students. *Behavior Research Methods*, *42*, 733–738. doi:10.3758/BRM.42.3.733

Krank, M. D., & Wall, A.-M. (2006). Context and retrieval effects on implicit cognitions for substance use. In R. W. Wiers & A. W. Stacy (Eds.), *Handbook of implicit cognition and addiction* (pp. 281–292). Thousand Oaks, CA: Sage. doi:10.4135/9781412976237.n19

Lev-Ran, S., Le Strat, Y., Imtiaz, S., Rehm, J., & Le Foll, B. (2013). Gender differences in prevalence of substance use disorders among individuals with lifetime exposure to substances: Results from a large representative sample. *The American Journal on Addictions*, *22*, 7–13. doi:10.1111/j.1521-0391.2013.00321.x

Littlefield, A. K., Vergés, A., Rosinski, J. M., Steinley, D., & Sher, K. J. (2013). Motivational typologies of drinkers: Do enhancement and coping drinkers form two distinct groups? *Addiction*, *108*, 497–503. doi:10.1111/j.1360-0443.2012.04090.x

McGillicuddy, N. B. (2006). A review of substance use research among those with mental retardation. *Mental Retardation and Developmental Disabilities Research Reviews*, *12*, 41–47. doi:10.1002/mrdd.20092

McGuire, B. E., Daly, P., & Smyth, F. (2007). Lifestyle and health behaviours of adults with an intellectual disability. *Journal of Intellectual Disability Research*, *51*, 497–510. doi:10.1111/j.1365-2788.2006.00915.x

Merikangas, K. R., & McClair, V. L. (2012). Epidemiology of substance use disorders. *Human Genetics*, *131*, 779–789. doi:10.1007/s00439-012-1168-0

Mezquita, L., Stewart, S. H., Ibáñez, M. I., Ruipérez, M. A., Villa, H., Moya, J., & Ortet, G. (2011). Drinking motives in clinical and general populations. *European Addiction Research*, *17*, 250–261. doi:10.1159/000328510

Read, J. P., Wood, M. D., Kahler, C. W., Maddock, J. E., & Palfai, T. P. (2003). Examining the role of drinking motives in college student alcohol use and problems. *Psychology of Addictive Behaviors*, *17*, 13–23. doi:10.1037/0893-164X.17.1.13

Rehm, J., Room, R., van den Brink, W., & Jacobi, F. (2005). Alcohol use disorders in EU countries and Norway: An overview of the epidemiology. *European Neuropsychopharmacology*, *15*, 377–388. doi:10.1016/j.euroneuro.2005.04.005

Reich, R. R., Below, M. C., & Goldman, M. S. (2010). Explicit and implicit measures of expectancy and related alcohol cognitions: A meta-analytic comparison. *Psychology of Addictive Behaviors*, *24*, 13–25. doi:10.1037/a0016556

Rooke, S. E., Hine, D. W., & Thorsteinsson, E. B. (2008). Implicit cognition and substance use: A meta-analysis. *Addictive Behaviors*, *33*, 1314–1328. doi:10.1016/j.addbeh.2008.06.009

Salemink, E., & Wiers, R. W. (2014). Alcohol-related memory associations in positive and negative affect situations: Drinking motives, working memory capacity, and prospective drinking. *Psychology of Addictive Behaviors*, *28*, 105–113. doi:10.1037/a0032806

Schippers, G. M., & Broekman, T. G. (2010). *De AUDIT. Nederlandse vertaling van de Alcohol Use Disorders Identification Test*. [Dutch translation of the Alcohol Use Disorders Identification Test.]. Retrieved from http://www.mateinfo.nl/audit/

Seedat, S., Scott, K. M., Angermeyer, M. C., Berglund, P., Bromet, E. J., Brugha T. S., … Kessler, R. C. (2009). Cross-national associations between gender and mental disorders in the World Health Organization World Mental Health Surveys. *Archives of General Psychiatry*, *66*, 785–795. doi:10.1001/archgenpsychiatry.2009.36

Slayter, E. M. (2008). Understanding and overcoming barriers to substance abuse treatment access for people with mental retardation. *Journal of Social Work in Disability & Rehabilitation*, *7*, 63–80. doi:10.1080/15367100802009780

Stacy, A. W., Ames, S. L., & Grenard, J. L. (2006). Word associations tests of associative memory and implicit processes: Theoretical and assessment issues. In R. W. Wiers & A. W. Stacy (Eds.), *Handbook of implicit cognition and addiction* (pp. 75–90). Thousand Oaks, CA: Sage. doi:10.4135/9781412976237.n6

Stacy, A. W., & Wiers, R. W. (2010). Implicit cognition and addiction: A tool for explaining paradoxical behavior. *Annual Review of Clinical Psychology*, *6*, 551–575. doi:10.1146/annurev.clinpsy.121208.131444

Steinhausen, H.-C., & Metzke, C. W. (2003). The validity of adolescent types of alcohol use. *Journal of Child Psychology and Psychiatry*, *44*, 677–686. doi:10.1111/1469-7610.00154

Steward, S. H., Hall, E., Wilkie, H., & Birch, C. (2002). Affective priming of alcohol schema in coping and enhancement motivated drinkers. *Cognitive Behaviour Therapy*, *31*, 68–80. doi:10.1080/16506070252959508

Thush, C., Wiers, R. W., Ames, S. L., Grenard, J. L., Sussman, S., & Stacy, A. W. (2007). Apples and oranges? Comparing indirect measures of alcohol-related cognition predicting alcohol use in at-risk adolescents. *Psychology of Addictive Behaviors*, *21*, 587–591. doi:10.1037/0893-164X.21.4.587

Uterwijk, J. M. R. (2000). *WAIS-III: Nederlandstalige bewerking: Wechsler Adult Intelligence Scale – Ed. 3: Afname en scoringshandleiding (WAIS-III 2000)*. Lisse, Nederland: Swets Test.

VanDerNagel, J. E. L., Kiewik, M., van Dijk, M., De Jong, C. A. J., & Didden, R. (2011). *Handleiding SumID-Q, Meetinstrument voor het in kaart brengen van middelengebruik bij mensen met een lichte verstandelijke beperking* [Manual of the SumID-Q, An instrument to assess substance use in individuals with a mild intellectual disability]. Deventer, Nederland: Tactus.

VanDerNagel, J. E. L., Kiewik, M., van Dijk, M., Didden, R., Korzilius, H. P. L. M., van der Palen, J., … de Jong, C. A. J. (2016). Substance use in individuals with mild to borderline intellectual disability: A comparison between self-report, collateral-report and biomarker analysis. *Research in Developmental Disabilities*. Advance online publication. doi:10.1016/j.ridd.2016.04.006

Van Duijvenbode, N., Didden, R., van den Hazel, T., & Engels, R. C. M. E. (2016). Psychometric qualities of a tetrad WAIS-III short form for use in individuals with mild to borderline intellectual disability. *Developmental Neurorehabilitation*, *19*, 26–30. doi:10.3109/17518423.2014.893265

Van Duijvenbode, N., Didden, R., Korzilius, H. P. L. M., & Engels, R. C. M. E. (2016). Everybody is … drinking! Interpretation bias in problematic drinkers with and without mild to borderline intellectual disability. *Journal of Mental Health Research in Intellectual Disabilities*, *9*, 101–117. doi:10.1080/19315864.2016.1166303

Volkow, N. D., Wang, G.-J., Tomasi, D., & Baler, R. D. (2013). Unbalanced neuronal circuits in addiction. *Current Opinion in Neurobiology*, *23*, 639–648. doi:10.1016/j.conb.2013.01.002

Woud, M. L., Becker, E. S., Rinck, M., & Salemink, E. (2015). The relationship between drinking motives and alcohol-related interpretation biases. *Journal of Behavior Therapy and Experimental Psychiatry*, *47*, 102–110. doi:10.1016/j.jbtep.2014.11.012

Woud, M. L., Fitzgerald, D. A., Wiers, R. W., Rinck, M., & Becker, E. S. (2012). 'Getting into the spirit': Alcohol-related interpretation bias in heavy-drinking students. *Psychology of Addictive Behaviors*, *26*, 627–632. doi:10.1037/a0029025

Woud, M. L., Hutschemaekers, M. H. M., Rinck, M., & Becker, E. S. (2015). The manipulation of alcohol-related interpretation biases by means of Cognitive Bias Modification – Interpretation (CBM-I). *Journal of Behavior Therapy and Experimental Psychiatry*, *49*, 61–68. doi:10.1016/j.jbtep.2015.03.001

Woud, M. L., Pawelczak, S., Rinck, M., Lindenmeyer, J., Souren, P., Wiers, R. W., & Becker, E. S. (2014). Alcohol-related interpretation bias in alcohol-dependent patients. *Alcoholism: Clinical & Experimental Research*, *38*, 1151–1159. doi:10.1111/acer.12334