

ARE DRINKERS IMPLICITLY POSITIVE ABOUT DRINKING ALCOHOL? PERSONALIZING THE ALCOHOL-IAT TO REDUCE NEGATIVE EXTRAPERSONAL CONTAMINATION

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Abstract — Aims: The advent of indirect measures, such as the Implicit Association test (IAT), has stimulated interest in implicit cognitions that may automatically steer addictive behaviours such as alcohol abuse. Counter-intuitively, recent IAT research has demonstrated that alcohol is implicitly associated with negative valence, regardless of the level of alcohol consumption. However, because the IAT is susceptible to extrapersonal contamination, this study examined whether previous findings reflect contamination of IAT effects by negative extrapersonal knowledge rather than personal associations with alcohol. **Methods:** Implicit alcohol associations were measured with a personalized alcohol-IAT, designed to reduce extrapersonal contamination. Whether alcohol associations measured with the personalized IAT would predict drinking behaviour above the variance explained by self-reported alcohol-related expectancies and attitude was examined. **Results:** In contrast to previous findings with the IAT, the personalized IAT yielded positive associations. Moreover, positive alcohol associations predicted drinking behaviour above self-reported alcohol expectancies and attitudes, demonstrating the incremental validity of the personalized IAT. **Conclusions:** The present findings support the hypothesis that previous findings with the alcohol-IAT at least partly reflect negative extrapersonal alcohol-related knowledge, and that implicit alcohol associations are positive rather than negative.

In the past years, there has been a growing interest in the role of implicit cognitions in the etiology and maintenance of addictive behaviours such as alcohol abuse. The reason is that, with increased substance abuse, cognitive processes underlying addictive behaviours develop automaticity and these automatic or implicit processes subsequently determine behaviour more than explicit, more controlled cognitive processes (e.g. Deutsch and Strack, 2006; Stacy, 1997). Importantly, such automatic processes are difficult, though not impossible, to assess with direct self-report measures. Moreover, direct measures can be influenced by biasing factors such as self-presentation (e.g. Holtgraves, 2004; Paulhus, 1984). In contrast, indirect measures, which infer cognitive processes indirectly from behaviour other than self-report, seem more resistant to self-presentation biases and may be uniquely suited to tap the automatic influence of alcohol-related cognitions on behaviour (e.g. De Houwer, 2006; De Houwer and Moors, in press).

The Implicit Association Test (IAT; Greenwald *et al.*, 1998) has now become one of the most frequently applied indirect measures in many areas of research including addiction research. The IAT is a classification task that involves participants classifying stimuli into two target categories and two attribute categories using two response keys. The idea is that this classification task should be easier when the response assignment of the target and attribute categories is compatible, or corresponds to respondents' implicit associations (e.g. flowers and positive vs insects and negative), than when the response assignment is incompatible, or does not match respondents' implicit associations (e.g. flowers and negative vs insects and positive). Hence, the performance difference

between the two response assignments should reflect the strength of the associations of the target categories with the attribute categories. Wiers *et al.* (2002) were the first to apply the IAT to study implicit alcohol-related cognitions in light and heavy drinkers. They found that both light and heavy drinkers responded faster when alcohol shared a response with negative and soda with positive, than when alcohol was paired with positive, and soda with negative. Hence, both light and heavy drinkers displayed strong negative associations with alcohol compared with soda, demonstrating that implicit evaluative associations with alcohol (vs soda) were unable to differentiate between light and heavy drinkers ($P = 0.18$), even though they were related to drinking behaviour. In contrast, light and heavy drinkers could be differentiated based on their self-reported positivity about drinking alcohol and based on their implicit arousal associations with alcohol relative to soda. Further, Wiers *et al.* (2005) also demonstrated strong negative implicit associations with alcohol relative to soda that were at best only moderately related to drinking behaviour in a sample of heavy drinkers.

Though the IAT can offer both a reliable and valid measure of implicit associations (e.g. Hofmann *et al.*, 2005; Nosek *et al.*, in press), there are methodological issues that may decrease the validity of the IAT. First, the IAT is a relative measure and can, thus, reflect implicit associations with alcohol, implicit associations with soda, or both (for a discussion of the influence of the soda contrast on findings with the alcohol-IAT see, for example, de Jong *et al.*, in press; Houben and Wiers, 2006a, 2006c). Second, recent research suggests that the IAT is not only influenced by implicit associations but also by recoding processes based on, for instance, familiarity, salience or any other information that can facilitate IAT performance (e.g. De Houwer *et al.*, 2005; Mierke and Klauer, 2003; Rothermund and Wentura, 2004, 2006; for the alcohol-IAT see also Houben and Wiers, 2006b; Houben *et al.*, 2006). Related to this issue, the IAT has been demonstrated to be

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sensitive to extrapersonal associations that are available in memory but that do not form the basis of one's attitudes and that are irrelevant to behaviour. Extrapersonal associations can stem from cultural norms (Karpinski and Hilton, 2001) or from other sources of information, including the media and other people (Olson and Fazio, 2004; Han *et al.*, 2006). Although such extrapersonal associations may affect how participants solve the mapping problem posed by the IAT, they can be distinguished from personal associations, which, unlike extrapersonal associations, guide behaviour once they are automatically activated (Olson and Fazio, 2004). The implication is that the alcohol-IAT may also be, to some extent, affected by extrapersonal contamination. Since information about the negative effects of alcohol abuse (compared to drinking soft drinks) is abundantly available in our society it is plausible that the alcohol-IAT, to some extent, reflects extrapersonal knowledge that is available in drinkers' memory but does not necessarily converge with one's personal attitudes, and associations. This could partly explain why the available evidence with the IAT suggests negative, rather than positive, implicit associations with alcohol, relative to soda, in heavy drinkers (e.g. Wiers *et al.*, 2002). However, since the alcohol-IAT was found to be at least moderately related to alcohol use, it is also clear that extrapersonal contamination cannot completely account for effects with the alcohol-IAT. Nevertheless, earlier findings with the IAT may underestimate the importance of implicit positive associations in drinking behaviour due to extrapersonal contamination and eliminating such extrapersonal contamination may increase the validity of the task as a measure of implicit associations with alcohol relative to soda.

According to Olson and Fazio (2004), three features of the IAT procedure contribute to contamination by extrapersonal associations. First, it is argued that the category labels 'positive' and 'negative' carry a normative implication. Second, category exemplars are typically normatively positive or negative. Finally, giving error feedback suggests that there is a normatively correct response. Therefore, Olson and Fazio introduced the personalized IAT which reduces extrapersonal contamination by replacing the labels 'positive' and 'negative' with the labels 'I like' and 'I dislike', by using exemplars that are not normatively associated with valence but that have little evaluative consensus (e.g. football, coffee) and by refraining from giving error feedback. Thus, the personalized IAT personalizes responses by allowing participants to classify stimuli without reference to normative information. In light of these findings, De Houwer *et al.* (2004) personalized the IAT by using the attribute labels 'liked' and 'disliked' as well as individually selected liked and disliked attribute stimuli, but still found support for implicit negative associations with alcohol, relative to soda, in alcoholics undergoing treatment. However, it should be noted that De Houwer *et al.* used an IAT that differs from the personalized IAT developed by Olson and Fazio (2004) in two aspects: First, the IAT used by De Houwer *et al.* presented attribute stimuli that were individually selected instead of idiosyncratic attribute stimuli which were the same for all participants. Second, De Houwer *et al.* did not use attribute category labels that unambiguously directed participants' focus to their own evaluation of the target concepts. Importantly, Han *et al.* (2006) demonstrated that, primarily, the use of such personalized labels reduces

extrapersonal contamination in the IAT. Hence, the IAT used by De Houwer *et al.* could still have been susceptible to extrapersonal contamination, which could explain why they were unable to find support for implicit positive associations with alcohol. Alternatively, negative experiences following alcohol use may have caused stronger negative associations in alcoholics in treatment (cf. Jones and McMahon, 1998).

The present study further explores whether previous findings with the alcohol-IAT could at least partly be due to extrapersonal contamination. Implicit alcohol-related cognitions were therefore measured with an IAT that was personalized as in Olson and Fazio (2004). It was expected that this personalized IAT would show positive rather than negative implicit associations with alcohol, compared to soda, in heavy drinkers, which would support the hypothesis that evidence for negative implicit associations with alcohol, relative to soda, as previously found with the alcohol-IAT, were to some extent due to extrapersonal contamination. In addition, the personalized IAT was expected to predict alcohol use and alcohol-related problems above explicit alcohol-related attitudes and expectancies.¹

METHOD

Participants

Forty-two male heavy drinking students of Maastricht University (mean age = 21 years, $SD = 4.5$) participated in exchange for a gift certificate. Recruitment took place in Maastricht University through advertisements. Interested students were administered a brief telephone interview regarding their weekly alcohol use. Only students who consumed at least 12 or more European standard drinks² per week were included in the study. Average alcohol consumption per week was 25.05 ($SD = 13.23$) European standard drinks. On the 18-items version of the Rutgers Alcohol Problem Index Rutgers Alcohol Problem Index (RAPI; White and Labouvie, 2000), participants had an average item score of 0.73 ($SD = 0.37$). The average item score within clinical samples is about 0.80 (White and Labouvie, 1989). On the Alcohol Use Disorder Identification Test Alcohol Use Disorder Identification Test (AUDIT; Saunders *et al.*, 1993), participants' mean score was 12.67 ($SD = 3.43$), while the proposed cut-off score for the screening of alcohol-related problems is 11.

MATERIALS AND MEASURES

Alcohol use

Alcohol use was measured with a questionnaire, based on the timeline follow-back method (Sobell and Sobell, 1990), that

¹ Although the personalized IAT, like the IAT, measures implicit associations with alcohol relative to soda, we did not include measures of explicit soda-related cognitions for two reasons: First, we were mainly interested in the prediction of alcohol use and we did not expect explicit soda-related cognitions to predict alcohol consumption. Second, Houben and Wiers (2006c) demonstrated that measures of explicit soda-related cognitions were unrelated to both alcohol versus soda IAT scores and drinking behaviour.

² A standard European alcoholic drink contains somewhat less alcohol than a standard English or American alcoholic drink: 10–12 g versus 14 g, respectively.

asked participants to indicate how many drinks of different types of alcoholic beverages they consumed during each day of the past week, and how many drinks they typically consumed on each day of the week (Wiers *et al.*, 1997).

Alcohol-related problems

Alcohol-related problems were assessed with the RAPI and the AUDIT. The RAPI asked participants to indicate how often they experienced 18 alcohol-related problem situations on a 5-point Likert scale (0 = never, 4 = very often) (Cronbach's $\alpha = 0.75$). The AUDIT consisted of 10 questions ($\alpha = 0.65$), the first three questions measured alcohol use, and the other seven questions assessed alcohol-related problems.

Personalized IAT

In the personalized IAT, two target categories were presented, one consisting of five alcoholic drinks (label 'alcohol') and the other of five soft drinks (label 'soda'). The alcohol and soda categories were matched on familiarity ($M = 5.22$, $SD = 1.29$, and $M = 5.64$, $SD = 2.12$, respectively; 1 = completely unfamiliar, 7 = very familiar), valence ($M = 4.42$, $SD = 0.92$, and $M = 4.44$, $SD = 0.88$, respectively; 1 = very negative, 7 = very positive), arousal ($M = 4.20$, $SD = 0.80$, and $M = 4.32$, $SD = 0.84$, respectively; 1 = very passive, 7 = very active) and number of syllables. Further, 10 attribute stimuli were presented that had to be classified into two attribute categories, labeled 'I like', and 'I dislike'. The attribute stimuli (familiarity: $M = 4.99$, $SD = 1.03$; arousal: $M = 4.47$, $SD = 0.50$) were overall evaluated as neutral on valence but had a large standard deviation ($M = 4.41$, average $SD = 1.56$), suggesting that they had little evaluative consensus (cf. Olson and Fazio, 2004). All stimuli are listed in the Appendix.

The personalized IAT was programmed in Experimental Run Time System Experimental Run Time System (ERTS) 3.18 (Beringer, 1996) and consisted of five blocks. Participants first practiced the target discrimination with a right and a left response key (e.g. 'alcohol' vs 'soda'). Target stimuli were presented twice, resulting in 20 trials. In the second block, they practiced the attribute classification (e.g. 'I like' vs 'I dislike') with the same response keys. All attribute stimuli were presented twice, resulting 20 trials. The third block was the first combination block during which both target and attribute stimuli were presented twice (e.g. 'alcohol' and 'I like' vs 'soda' and 'I dislike') and consisted of 40 trials. Next, participants received 20 trials during which they practiced the reversed attribute discrimination, followed by the reversed combination block (e.g. 'alcohol' and 'I dislike' vs 'soda' and 'I like') which consisted of 40 trials. Target and attribute stimuli were presented randomly in alternating order. Stimuli were presented in the middle of the computer screen, in black against a grey background. Instructions were presented before each task. During the task, the labels of the categories assigned to the left and right response key were presented in the corresponding upper corners of the computer screen. Stimuli remained on screen until a response was given. The intertrial interval was 250 ms. No feedback was presented.

Explicit expectancies and attitudes

The explicit alcohol-related expectancy questionnaire consisted of six positive expectancy items ($\alpha = 0.84$), and six negative expectancy items ($\alpha = 0.86$). For each item, participants indicated on a 100 mm Visual Analogue Scale Visual Analogue Scale (VAS) how much they agreed (0 = completely disagree, 100 = completely agree) with the statement: 'After drinking alcohol, I feel . . .' which was completed with the following words: pleasant, happy, sociable, funny, amusing, and outgoing for the positive expectancy items; miserable, sad, lonely, gloomy, unpleasant, and unhappy for the negative expectancy items. The explicit alcohol attitude questionnaire consisted of four semantic differentials: Participants indicated on a 100 mm VAS how much they considered drinking alcohol to be unpleasant-pleasant, bad-good, boring-fun, and stupid-smart. The first and third item formed an affective attitude component ($\alpha = 0.65$), the other two items a cognitive attitude component ($\alpha = 0.68$).

Procedure

After giving consent, participants performed the personalized IAT. The response assignment of the target categories to the left and right response was counterbalanced. Also, the order of the two combination tasks in the IAT was counterbalanced so that half the participants first performed the IAT with 'alcohol' assigned to the same response as 'I like' (vs 'soda' and 'I dislike') and then received the reversed combination task in which 'alcohol' was paired with 'I dislike' (vs 'soda' and 'I like'), whereas the other half of the participants received the two combination tasks in reversed order.³ Afterwards, participants filled out the expectancy questionnaire, the attitude questionnaire, the alcohol use questionnaire, the AUDIT and the RAPI, in this order. Finally, participants judged all IAT stimuli on familiarity, valence and arousal.

RESULTS

Implicit alcohol associations

IAT effects were calculated with the D600 scoring algorithm (Greenwald *et al.*, 2003). Following the formula presented by Greenwald *et al.*, practice blocks were included, error penalties (600 ms) were given, and results were standardized at the level of the participant. The D600 measure was calculated so that higher scores indicate faster performance when 'alcohol' was paired with 'I dislike' (vs 'soda' and 'I like'), than when 'alcohol' and 'I like' shared a response (vs. 'soda' and 'I dislike'). Preparatory analyses revealed no influential outliers on IAT data. Results yielded a borderline significant IAT effect, $t(41) = -1.96$, $P = 0.056$, $d = 0.30$, indicating that participants, if anything, associated alcohol, as compared to soda, more with positive than with negative valence.

³ Results showed no difference between these two counterbalancing conditions with respect to alcohol use or alcohol-related problems ($ps > 0.65$).

Table 1. Summary of hierarchical regression analysis for the prediction of alcohol use by explicit alcohol-related cognitions and personalized IAT scores^a

| Step | Variable | B | SE B | β | β | t | P |
|------|-------------------------------|-------|------|---------|---------|-------|-------|
| 1 | Positive alcohol expectancies | -0.02 | 0.01 | -0.37 | 0.22 | -1.65 | 0.109 |
| | Negative alcohol expectancies | -0.00 | 0.01 | 0.05 | 0.17 | 0.27 | 0.785 |
| | Affective attitude component | 0.03 | 0.01 | 0.62 | 0.22 | 2.83 | 0.008 |
| | Cognitive attitude component | -0.00 | 0.01 | -0.03 | 0.17 | -0.18 | 0.858 |
| 2 | Positive alcohol expectancies | -0.02 | 0.01 | -0.36 | 0.21 | -1.72 | 0.095 |
| | Negative alcohol expectancies | 0.01 | 0.01 | 0.12 | 0.17 | 0.70 | 0.490 |
| | Affective attitude component | 0.03 | 0.01 | 0.51 | 0.21 | 2.39 | 0.022 |
| | Cognitive attitude component | -0.00 | 0.01 | -0.03 | 0.16 | -0.18 | 0.861 |
| | Personalized IAT | -0.38 | 0.17 | -0.36 | 0.16 | -2.28 | 0.029 |

^a The personalized IAT was scored so that positive values indicate faster responses if 'alcohol' was paired with 'I dislike' and 'soda' with 'I like'. Note: $F(4, 36) = 2.09$, $P = 0.103$, $R^2 = 0.19$, for step 1; $F_{\text{change}}(1, 35) = 5.18$, $P = 0.029$, $R^2_{\text{change}} = 0.11$, for step 2. Final model: $R^2 = .29$, $R^2_{\text{adjusted}} = 0.19$, $F(5, 35) = 2.90$, $P = 0.027$.

Table 2. Summary of hierarchical regression analysis for the prediction of alcohol-related problems by explicit alcohol-related cognitions and personalized IAT scores^a

| Step | Variable | B | SE B | β | β | t | P |
|------|-------------------------------|-------|------|---------|---------|-------|-------|
| 1 | Positive alcohol expectancies | -0.02 | 0.02 | -0.21 | 0.21 | -0.97 | 0.337 |
| | Negative alcohol expectancies | -0.01 | 0.01 | -0.16 | 0.17 | -0.92 | 0.366 |
| | Affective attitude component | 0.03 | 0.01 | 0.38 | 0.20 | 1.95 | 0.059 |
| | Cognitive attitude component | -0.01 | 0.01 | -0.09 | 0.17 | -0.52 | 0.606 |
| 2 | Positive alcohol expectancies | -0.02 | 0.02 | -0.24 | 0.21 | -1.15 | 0.256 |
| | Negative alcohol expectancies | -0.01 | 0.01 | -0.07 | 0.17 | -0.44 | 0.666 |
| | Affective attitude component | 0.02 | 0.01 | 0.33 | 0.19 | 1.73 | 0.092 |
| | Cognitive attitude component | -0.01 | 0.01 | -0.08 | 0.16 | -0.49 | 0.630 |
| | Personalized IAT | -0.51 | 0.25 | -0.33 | 0.16 | -2.05 | 0.047 |

^a The personalized IAT was scored so that positive values indicate faster responses if 'alcohol' was paired with 'I dislike' and 'soda' with 'I like'. Note: $F(4, 37) = 1.37$, $P = 0.264$, $R^2 = 0.13$, for step 1; $F_{\text{change}}(1, 36) = 4.21$, $P = .047$, $R^2_{\text{change}} = 0.09$, for step 2. Final model: $R^2 = 0.22$, $R^2_{\text{adjusted}} = 0.11$, $F(5, 36) = 2.03$, $P = 0.098$.

Explicit alcohol-related expectancies and attitudes

A comparison of mean positive expectancy scores ($M = 66.62$, $SD = 10.22$) and mean negative expectancy scores ($M = 22.60$, $SD = 10.94$), showed that participants agreed significantly more with positive expectancies than with negative expectancies, $t(41) = 16.36$, $P < 0.001$. Further, participants' mean affective attitude score ($M = 74.11$, $SD = 12.14$) deviated significantly from the midpoint of the scale, $t(41) = 12.87$, $P < 0.001$, indicating that participants had a positive attitude towards alcohol. Mean cognitive attitude scores ($M = 47.79$, $SD = 14.17$), however, did not deviate from the midpoint of the scale, $t(41) = -1.01$, $P = 0.317$. We then examined the relationship of the personalized IAT with alcohol-related expectancies and attitudes. The personalized IAT was significantly correlated with negative expectancies, $r = 0.33$, $P = 0.031$, and borderline significantly correlated with both positive expectancies, $r = -0.29$, $P = 0.067$, and the affective attitude component, $r = -0.30$, $P = 0.056$. The personalized IAT was uncorrelated with the cognitive attitude component, $r = 0.03$, $P = 0.873$.

Relationship of implicit associations to alcohol use and related problems

An estimate of alcohol use was calculated as the mean of average alcohol consumption during the past week and average weekly alcohol consumption.⁴ Further, average alcohol use during the past week and average alcohol use were first log-transformed in order to obtain a normal distribution for the alcohol use estimate. An estimate for mean alcohol-related problems was computed as the mean of the z-transformed RAPI and AUDIT sum scores. To obtain a normal distribution, RAPI and AUDIT sum scores were first log-transformed. The estimates of alcohol use and alcohol-related problems were significantly correlated, $r = 0.49$, $P = 0.001$, indicating that participants with increased levels of alcohol consumption also experienced more alcohol-related problems. The personalized IAT correlated significantly with both alcohol use, $r = -0.43$, $P = 0.005$, and alcohol-related problems, $r = -0.39$, $P = 0.012$. Next, we tested the predictive validity of both the explicit measures and the personalized IAT.

⁴ Average weekly alcohol consumption and average alcohol consumption during the past week correlated significantly, $r = 0.55$, $P < 0.001$. Moreover, the pattern of results was generally the same when results were analyzed separately for these two dependent variables. It was, therefore, decided to use the composite score as the dependent variable in all analyses reported here.

The hierarchical regression analysis predicting alcohol use is shown in Table 1. Inspection of the Cook's distances showed one influential case. This participant was therefore excluded from the hierarchical regression analysis. Explicit alcohol-related expectancies and attitudes were entered in step 1 of the regression analysis while the personalized IAT was entered in step 2. In step 1, only the affective attitude component significantly predicted alcohol use. In step 2, the personalized IAT significantly predicted alcohol use above the variance explained by the affective attitude component. The same procedure was followed for the prediction of alcohol-related problems (see Table 2). None of the explicit measures entered in step 1 significantly predicted alcohol-related problems, whereas the personalized IAT entered in step 2 significantly increased the variance explained. Results demonstrated that only the personalized IAT significantly predicted alcohol-related problems.

DISCUSSION

Previous studies counter intuitively demonstrated negative implicit associations with alcohol relative to soda, in heavy drinkers that were at best moderately related to drinking behaviour (e.g. De Houwer *et al.*, 2004; Wiers *et al.*, 2002, 2005). Recent research, however, suggests that the IAT does not necessarily reflect implicit associations but can also be affected by a variety of recoding processes, including extrapersonal knowledge (e.g. Han *et al.*, 2006; Olson and Fazio, 2004). Hence, previous findings with the alcohol-IAT could at least partly reflect negative extrapersonal information about drinking alcohol (as opposed to soft drinks) that is attitude-irrelevant, which could have decreased the validity of the IAT as a measure of implicit associations with alcohol. Therefore, in this study, implicit alcohol associations were measured with a personalized alcohol-IAT designed to eliminate extrapersonal contamination (Olson and Fazio, 2004). Further, it should be noted that, unlike Wiers *et al.* (2002) but similar to Wiers *et al.* (2005), we only included heavy drinkers because we were primarily interested in the predictive validity of the personalized IAT as a measure of implicit associations with alcohol that determine alcohol use, and such automatic cognitive processes are developed only after repeated alcohol use. Importantly, whereas, previous studies demonstrated negative implicit associations with alcohol relative to soda in heavy drinkers with a traditional IAT (e.g. De Houwer *et al.*, 2004; Wiers *et al.*, 2005), the personalized IAT used in this study showed no evidence for negative implicit associations with alcohol. If anything, the present findings indicated stronger positive implicit associations with alcohol compared to soda in heavy drinkers, though this effect was only borderline significant. Further, positive implicit alcohol associations predicted alcohol consumption and alcohol-related problems above explicit attitudes toward drinking alcohol. Hence, the present results suggest that previous evidence for stronger negative implicit associations with alcohol than with soda was at least partly caused by extrapersonal contamination in the alcohol-IAT and indicate relatively positive personal implicit associations with alcohol compared to soda. However, it is important to note that the present results cannot allow any final conclusions with respect to differences

in validity between the traditional alcohol-IAT and the personalized alcohol-IAT. In order to show that the traditional alcohol-IAT indeed reflects extrapersonal contamination to a larger extent than the personalized alcohol-IAT, future research should directly compare these two tasks within one single study.

The present results are also consistent with studies that have assessed implicit alcohol-related cognitions in a unipolar format (e.g. positive vs neutral and negative vs neutral) rather than in a bipolar format (e.g. positive vs negative), as is typically done in IAT research. It became evident that alcohol is not only implicitly associated more strongly with negative valence than soda, but also more strongly with positive valence (Houben and Wiers, 2006a; Jajodia and Earleywine, 2003). Importantly, studies with the unipolar IAT also showed that positive implicit associations with alcohol, relative to soda, were at least moderately related to alcohol-related behaviour whereas negative implicit alcohol associations were not. Together, these results suggest that alcohol, relative to soda, is more easily paired with a negative attribute category than with a positive attribute category (in a bipolar IAT) because of negative extrapersonal knowledge. Importantly, when such extrapersonal contamination is reduced in the bipolar IAT, for example by personalizing the IAT, or when implicit alcohol associations are tested in a unipolar format, findings suggest stronger positive implicit associations with alcohol (or possibly ambivalent associations) than with soda, which are meaningfully related to drinking behaviour.

Further, it should be noted that the personalized IAT, like the traditional IAT, is a relative measure. The present findings, therefore, cannot differentiate between the possibility that drinking behaviour is related to a relatively strong liking for alcohol and/or a relatively strong dislike for soda. Moreover, the personalized IAT may also reflect recoding processes, based on, for instance, salience, rather than implicit associations. Hence, future research needs to examine to what extent the personalized IAT reflects personal associations with alcohol and/or soda, as well as how recoding processes may affect the personalized IAT. Importantly, there are also other indirect measures available, such as affective priming and the Extrinsic Affective Simon Task Extrinsic Affective Simon Task (EAST; De Houwer, 2003), that are not relative and which may be less susceptible to both recoding influences and extrapersonal contamination. One caveat, however, is that less optimal reliabilities have been found for both the EAST (De Houwer, 2003), and priming measures (Cunningham *et al.*, 2001), compared to the IAT. Using the EAST, de Jong *et al.* (in press) recently demonstrated positive implicit soda associations and neutral or ambivalent implicit alcohol associations in both light and heavy drinkers, and similar findings have also been reported for alcoholics (De Houwer *et al.*, 2004). Moreover, De Jong *et al.* demonstrated that positive implicit alcohol associations predicted drinking behaviour, which is consistent with the present findings as well as with findings with unipolar IATs (e.g. Houben and Wiers, 2006a). Together, these findings support the conclusion that implicit positive associations with alcohol are important determinants of alcohol use.

Finally, as one reviewer noted, a limitation to the present results could be that some of the attribute stimuli used in the personalized IAT (e.g. soccer, disco) could have been

inadvertently differentially associated with alcohol and soda. While it should be noted that the IAT primarily measures implicit associations at category level rather than at the level of individual stimuli (e.g. De Houwer, in press), it is unclear whether the same also holds for the personalized IAT. Therefore, we cannot exclude the possibility that external alcohol associations with some of the attribute stimuli used in the personalized IAT may have influenced the present results.

In conclusion, the present study increases our understanding of automatic cognitive processes that are involved in alcohol use and misuse, but also carries implications with respect to interventions. Specifically, the present results suggest that it might be useful for future interventions to simultaneously target both explicit and implicit alcohol-related cognitions. Current interventions are typically aimed at changing explicit alcohol-related cognitions, making people aware of the negative consequences of their addictive behaviour and devaluating the positive consequences. However, if implicit alcohol-related cognitions, and more specifically implicit positive associations with alcohol (as well as implicit arousal associations with alcohol), are not also subject to change during such interventions, they will continue to automatically steer addictive behaviour in the future (cf. Wiers *et al.*, 2005). It is, therefore, interesting for future research to search for new ways to reduce the strength or the impact of positive implicit alcohol associations, as well as to examine whether personally relevant implicit negative associations with alcohol can be created that reduce consumption. Moreover, recent research suggests that executive functions can act as a moderator of the relationship between implicit alcohol associations assessed with the IAT and drinking behaviour (Thush *et al.*, 2006). Future research should, therefore, also examine whether executive functions can be trained and whether such an approach could be effective in changing the automatic influence of implicit alcohol associations on drinking behaviour.

APPENDIX

Target Stimuli

Alcohol:

beer, wine, whisky, drink, vodka

Soda:

Fanta, Coca Cola, Sprite, sinas (lemonade), ice-tea

Attribute Stimuli

Coffee, spinach, garlic, art, soccer, jogging, secret, cleaning, disco, museum

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