Alcohol approach tendencies in heavy drinkers: Comparison of effects in a Relevant

Stimulus-Response Compatibility Task and an approach / avoidance Simon task

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Abstract

Several recent studies suggest that alcohol-related cues elicit automatic approach tendencies in heavy drinkers. A variety of tasks have been used to demonstrate these effects, including Relevant Stimulus-Response Compatibility (R-SRC) tasks, and variants of Simon tasks. Previous work with normative stimuli suggests that the R-SRC task may be more sensitive than Simon tasks because the activation of approach tendencies may depend on encoding of the stimuli as alcohol-related, which occurs in the R-SRC task but not in Simon tasks. Our aim was to directly compare these tasks for the first time in the context of alcohol use. We administered alcohol versions of an R-SRC task and a Simon task to 62 social drinkers who were designated as heavy or light drinkers based on a median split of their weekly alcohol consumption. Results indicated that, compared to light drinkers, heavy drinkers were faster to approach rather than avoid alcohol-related pictures in the R-SRC task, but not in the Simon task. Theoretical implications and methodological issues are discussed.

Key words: alcohol; automatic approach; stimulus-response compatibility

As predicted by incentive-motivational theories of addiction (e.g. Robinson & Berridge, 1993), drug-related cues elicit automatic approach responses in substance users. Two broad types of tasks have been developed to measure these responses: Relevant Stimulus-Response Compatbility (R-SRC)[1] tasks and Simon tasks. The tasks can be distinguished on the basis of whether participants are required to process the alcohol-relatedness of the stimuli that are presented during the task, or not. In the R-SRC task, participants are required to categorize alcohol-related and neutral images by moving a manikin towards one type of image, and away from the other type of image. The task is typically split into two blocks: in the 'approach alcohol' block, participants are instructed to move the manikin towards alcohol-related images, and away from neutral images. In the 'avoid alcohol' block, instructions are reversed (i.e move the manikin towards neutral images, and away from alcohol images). Response latencies in the two blocks can be compared, and if participants are faster during the 'approach alcohol' block compared to the 'avoid alcohol' block, we infer that associations between the concepts 'alcohol' and 'approach' are stronger than associations between the concepts 'alcohol' and 'avoidance'. Several studies that used the task have demonstrated that tobacco smokers (Bradley, Field, Mogg, & De Houwer, 2004; Bradley, Field, Healy, & Mogg, 2008; Mogg, Bradley, Field, & De Houwer, 2003), cannabis users (Field, Eastwood, Bradley, & Mogg, 2006), and heavy drinkers (Field, Kiernan, Eastwood, & Child, 2008) are faster to categorise pictures related to these drugs when the appropriate response is one of symbolic approach, rather than avoidance.

Automatic approach tendencies have also been examined using Simon tasks, in which the alcohol-relatedness of the stimuli is not relevant for task performance. For instance, in the alcohol approach avoidance task (AAT), participants categorise alcohol-related and unrelated pictures by moving a joystick towards or away from the screen on the basis of the orientation

of the picture (portrait or landscape). In order to create the sensations of approach and avoidance, pictures grow larger in response to an approach movement, and smaller in response to an avoidance movement. Using the task, Wiers et al. (2009) showed that heavy drinkers were faster to approach (pull) than avoid (push) alcohol-related pictures. The effect was more pronounced among heavy drinkers who had a genetic variant that had previously been associated with alcohol problems (the OPRM-1 g-allele), and the effect was absent in light drinkers. Therefore, this study suggests that Simon tasks can be used to detect automatic alcohol approach tendencies evoked by alcohol stimuli in heavy drinkers. Note, however, that in a more recent study with an adolescent sample, the alcohol approach bias index was *negatively* correlated with individual differences in alcohol consumption. That is, the approach bias was larger in lighter drinkers (van Hemel-Ruiter et al., 2010).

It is important to clarify the mechanisms that underlie automatic approach tendencies and identify the most appropriate tools for their assessment, as this can contribute to the theoretical debate on the automaticity of approach and avoidance (see Krieglmeyer et al., 2010), as well as lead to novel treatment interventions for addiction (e.g. Wiers et al., 2010a,b). Previous studies that investigated automatic approach and avoidance responses elicited by normatively valenced stimuli found that effects tended to be weaker in Simon tasks (in which participants did not have to judge the valence of the stimuli) compared to R-SRC tasks (in which participants had to make an explicit judgment about the valence of the stimuli) (Krieglmeyer & Deutsch, 2010; Lavender & Hommel, 2007; Rotteveel & Phaf, 2004). Based on these findings with normatively valenced stimuli, one might expect that the R-SRC task would be more sensitive than the Simon task in terms of its ability to detect automatic approach tendencies elicited by alcohol cues in heavy drinkers. As noted above, the fact that the available results tend to be less consistent when the alcohol AAT (a form of Simon task) is used, compared to R-SRC tasks, already provides some evidence in support of

this hypothesis in the context of alcohol use. However, a head-to-head comparison of R-SRC and Simon tasks would be much more informative about the relative merits of the two tasks.

In order to perform a head-to-head comparison, we used versions of the R-SRC task and Simon task that were as similar as possible except for the task relevance of alcohol-related information. In the R-SRC task, participants moved a manikin towards or away from pictures on the basis of their alcohol-relatedness (towards alcohol in one block, away from alcohol in a different block). In the Simon task, participants were required to categorise the same alcohol-related and control pictures on the basis of their orientation (portrait or landscape; cf. Huijding & De Jong, 2005a, b) by moving a manikin towards or away from the pictures. Therefore, our Simon task differs from the alcohol AAT in that it does not utilize joystick movements and zooming effects to create impressions of approach and avoidance. However, unlike the alcohol AAT, our version of the Simon task uses the same type of responses and stimulus presentations as the R-SRC task. A group of social drinkers, who were categorised as either heavy or light drinkers, completed both tasks. We hypothesised that, compared to light drinkers, heavy drinkers would be faster to approach rather than avoid alcohol-related pictures in the R-SRC task. The crucial question was whether this effect would also be apparent in the Simon task, and if the effect would be equally strong in the two tasks. Any difference between the tasks would inform us about the relative sensitivity of R-SRC and Simon tasks for capturing automatic approach tendencies that are evoked by alcohol-related cues.

Method

Participants

Sixty two participants (25 men, 37 women) were recruited via word of mouth from various sites in the North West of England, but primarily customers at a fitness centre, and

staff at a supermarket. Inclusion criteria included social drinking (consumption of at least one

alcoholic drink per week), no history of self-reported alcohol abuse or alcohol problems, and

aged between 18 and 40 years old. The mean age of participants was 23.55 years (SD = 4.67).

Participants' average weekly alcohol consumption was 22.38 UK units (SD = 22.00; 1 unit =

8g alcohol) and the mean score on the AUDIT was 12.32 (SD = 5.11). All participants

provided informed consent before taking part in the study, which was approved by the

University of Liverpool Research Ethics Committee.

Materials

Five alcohol-related photographs were each matched with a control photograph; the

pictures were selected from picture sets used in previous research in our laboratory (e.g.

Field, et al., 2008). Alcohol-related pictures depicted alcoholic drinks (e.g. beer, cider, wine,

or vodka), or close-up shots of individuals consuming those drinks. Each alcohol-related

picture was matched with a control photograph on perceptual characteristics such as

brightness and complexity. Control photographs depicted items of stationery (e.g. a tin of

pens), or close-up shots of individuals interacting with items of stationery (e.g. a close up

shot of an individual licking an envelope). Each picture had originally been taken in

landscape format, such that it was 125mm wide by 100mm high when presented on the

computer screen. Pictures were cropped and resized using image manipulation software so

that they were also available in portrait format (75mm wide by 100mm high when presented

on the computer screen).

Procedure

Participants initially provided informed consent before completing a short battery of

questionnaires which included the Alcohol Use Disorders Identification Task (AUDIT;

Saunders, Aasland, Babor, De la Fuente, & Grant, 1993). Participants also completed a

retrospective Timeline Followback (TLFB; Sobell & Sobell, 1992) questionnaire in which

they indicated their alcohol consumption, in UK alcohol units over the preceding seven days.

Participants then completed two blocks of a relevant Stimulus-Response

Compatibility (R-SRC) task, and two blocks of an approach / avoidance Simon task, on a

laptop computer. Participants were initially provided with general information about the task,

which required them to quickly categorise photographs by making a manikin move either

towards or away from the picture by pressing keys labelled 'up' and 'down' on the computer

keyboard. Each block of each task comprised eight practice trials (from which data were not

analysed) and 40 critical trials. During each of the 40 critical trials, the five alcohol-related

and matched control pictures were presented four times each, twice in portrait format and

twice in landscape format. A small manikin (a black and white matchstick man) was

presented either directly above or directly below each picture on every trial. For each picture

in each format, the manikin was presented above the picture on half of the trials, and below

the picture on the other half of trials. Participants could move the manikin up or down the

screen - towards or away from the picture, depending on the starting position of the manikin -

by pressing the corresponding key on the keyboard. If participants responded correctly, the

manikin moved towards the picture and the entire screen was cleared once the manikin

reached the picture (1s). If participants responded incorrectly, a large red 'X' appeared in the

centre of the screen for 1s, before the screen was cleared. There was an inter-trial interval of

500ms.

In the R-SRC task, participants were instructed to categorise the pictures on the basis

of their alcohol-relatedness, but regardless of orientation. In the 'approach alcohol' block,

participants were instructed to make the manikin move towards the pictures if they were

alcohol-related, but away from the pictures if they were stationery-related. In the 'avoid

alcohol' block, participants were instructed to move the manikin towards the pictures if they were related to stationery, but away from the pictures if they were alcohol-related.

In the Simon task, participants were instructed to categorise pictures on the basis of their orientation, but regardless of content. In the 'approach portrait' block, participants were instructed to make the manikin move towards pictures if they were in portrait format, but away from pictures if they were in landscape format. In the 'approach landscape' format, participants were instructed to move the manikin towards the pictures if they were in landscape format, but away from the pictures if they were in portrait format. Hence, as was the case for the R-SRC task, the Simon task consisted of two blocks with different stimulus-response assignments. The only difference was that in the R-SRC task, the alcohol-relatedness of the pictures was relevant for categorization whereas in the Simon task, the orientation of the pictures was relevant.

In all blocks, stimuli were presented in a new random order for each participant. Reaction times (the time taken to initiate movement of the manikin) and errors were recorded on each trial. Participants completed the R-SRC and approach / avoidance Simon tasks, and sub-blocks within each task, in counterbalanced order, with the restriction that all participants completed both blocks of the R-SRC task before completing both blocks of the approach / avoidance Simon task, or vice versa.

After completion of the tasks, all participants were thanked for their time before being debriefed. Participants received no financial compensation for taking part.

Data reduction and analysis

Reaction time data from the R-SRC and approach / avoidance Simon tasks were analysed as in previous studies (e.g. Field, et al., 2008). First, trials with errors were discarded. Then, outlying reaction times were removed if they were faster than 200ms, slower

than 3000ms, and then if they were more than 3 standard deviations above the individual

mean. All data from five participants were excluded as they had a high rate of missing data

due to errors and outliers (>20%). The mean amount of missing data for the rest of the

sample was 5% due to errors and 4% due to outliers (9% in total). Participants tended to

make more errors on the approach / avoidance Simon task compared to the R-SRC task (6%

vs. 4%, $t(56) = 2.32$, $p < .05$), although the amount of data excluded as outliers was similar in

approach / avoidance Simon and R-SRC tasks (4% in both tasks; $t(56) = .07$, $p > .1$).

Once error and outlier trials had been removed, condition means were calculated. For

the R-SRC task, we took the average reaction time on the 'approach alcohol' block (i.e.,

speed to approach alcohol pictures *and* avoid control pictures), and the mean latency on the

'avoid alcohol' block (i.e. speed to avoid alcohol pictures and approach control pictures). For

the approach / avoidance Simon task, we computed a mean latency to 'approach alcohol'

(speed to approach alcohol pictures and avoid control pictures), and a mean latency to 'avoid

alcohol' (speed to avoid alcohol pictures and approach control pictures). Note that in both

blocks of the Simon task, participants were required to approach alcohol pictures on some

trials, and avoid them on others, dependent on the spatial orientation of the pictures.

Therefore, 'approach alcohol' and 'avoid alcohol' latencies were calculated across blocks

(e.g., 'approach alcohol' latencies referring to speed of approaching landscape format alcohol

pictures in one block, and the speed of approaching portrait format pictures in the other

block). Finally, we also computed 'approach bias' scores, separately for the R-SRC and

Simon tasks, by subtracting reaction times to 'approach alcohol' from reaction times to

'avoid alcohol', such that positive scores indicate faster reaction times when required to

approach, rather than avoid, alcohol-related pictures.

Participants were designated as 'heavy' or 'light' drinkers based on a median split of

self-reported weekly alcohol consumption. This median split was conducted separately on

male and female participants, because males consumed significantly more alcohol than

females (31 vs. 16 units per week; t(55) = 2.44, p < .05).

Results

Data are shown in Figure 1. Reaction time data were analysed with a 2 x 2 x 2 mixed

design ANOVA, with a between-subjects factor of Group (heavy drinkers / light drinkers),

and within-subject factors of Task Type (R-SRC task, Simon task) and Response Type

(approach alcohol, avoid alcohol). This revealed a significant main effect of task type (F(1,

55) = 8.00, $p < .01$), as participants were faster on the approach / avoidance Simon task than

on the R-SRC task. Importantly, the three way interaction between group, task type, and

response type was statistically significant (F(1, 55) = 5.83, $p < .05$). To interpret this

interaction, we performed 2 x 2 ANOVAs followed by post-hoc t-tests separately on heavy

and light drinkers. Among light drinkers, neither the main effect of response type, nor the

task type x response type interaction, were statistically significant ($Fs < 1$, $ps > .1$). However,

among heavy drinkers, the task type x response type interaction was statistically significant

(F(1, 25) = 5.38, $p < .05$). Heavy drinkers were faster to approach rather than avoid alcohol

pictures when performing the R-SRC task (t(25) = 2.16, $p < .05$), but this was not evident on

the approach / avoidance Simon task (t(25) = 1.12, $p > .1$). Among light drinkers, neither of

these planned contrasts were statistically significant ($ts < 1$, $ps > .1$).

We also examined the split-half reliability of the two 'approach bias' indices, and

investigated whether these indices were correlated with self-reported weekly alcohol

consumption, across the whole sample. Split-half reliability was determined by calculating

the approach bias indices, as described above, separately for the first and second halves of

trials in each experimental condition. These two indices were then correlated with each other.

The Simon task had very poor reliability (r = 0.04, p > .1), but reliability was better for the R-

SRC task ($r = 0.46$, $p < .001$). Weekly alcohol consumption was significantly positively

correlated with the approach bias index from the R-SRC task (Spearman's rho = 0.28, p <

.05), but not with the approach bias index from the Simon task (rho = -0.01, p > .1)[2].

Discussion

Results indicated that heavy drinkers were significantly faster to approach rather than

avoid alcohol-related pictures when performing the R-SRC task, in which the alcohol-

relatedness of the pictures was the relevant feature. However, when participants completed a

Simon task in which they categorised the same set of pictures on the basis of an irrelevant

feature (spatial orientation) this effect was not found. Among a control group of light

drinkers, latencies to approach and avoid alcohol pictures were similar in both tasks. These

results suggest that alcohol-related pictures do elicit automatic approach tendencies among

heavy (but not light) drinkers, but the R-SRC task is better suited to capture these effects than

the version of the Simon task that we used in the present study.

Results from the R-SRC task were entirely consistent with previous findings. Heavy

drinkers, but not light drinkers, were faster to categorise alcohol-related pictures by making a

symbolic approach response rather than by making a symbolic avoidance response. This

replicates previous findings (Field, et al., 2008; see also Schoenmakers, Wiers, & Field,

2008) and is also consistent with data from tobacco smokers (Bradley, et al., 2004, 2008;

Mogg, et al., 2003) and cannabis users (Field, et al., 2006). However, speeded approach

towards alcohol-related pictures was not evident in the Simon task, in which participants

categorised alcohol-related pictures on the basis of an irrelevant feature (their spatial

orientation). Some previous studies that used a different Simon task – the alcohol AAT - did

demonstrate that heavy drinkers were faster to approach rather than avoid alcohol-related

pictures (Wiers, et al., 2009, 2010a, b). However, as noted in the Introduction, this pattern has

not been consistently replicated (see van Hemel-Ruiter et al., 2010). When the results from

the present study are considered alongside these studies, we cannot conclude that Simon tasks are unable to capture automatic approach tendencies elicited by alcohol-related cues, although we can conclude that R-SRC tasks may be better suited to measure these tendencies.

There are a number of explanations for why our Simon task was less sensitive for detecting automatic approach tendencies than the R-SRC task. Drawing on previous work that investigated approach and avoidance tendencies that are evoked by normatively valenced stimuli (e.g. Krieglmeyer & Deutsch, 2010), one candidate explanation is that automatic approach tendencies are not reliably elicited by alcohol-related cues, but are only activated when participants explicitly encode the alcohol-relatedness of the cues. A related observation is that our Simon task had very low reliability (as compared to the R-SRC task), which is likely to contribute to its reduced sensitivity to individual differences in alcohol consumption. However, as noted above, investigators who used a different version of the Simon task (i.e., the alcohol AAT; e.g., Wiers et al., 2009) did detect automatic approach tendencies in heavy drinkers, at least in some studies. It is possible that some methodological features of the alcohol AAT, including the use of real (rather than symbolic) approach movements and the use of the zooming feature to create the sensations of approach and avoidance, may increase the sensitivity and reliability of the alcohol AAT as compared to the version of the Simon task that was used in the present study. It is also notable that in the R-SRC task the approach-alcohol trials are blocked together, whereas they are intermixed in the Simon task and AAT. It is possible that heavy drinkers, but not light drinkers, find the blocked approach-alcohol trials more rewarding than the blocked avoid-alcohol trials when performing the R-SRC task, which may explain why they are faster on the former block. It may be possible to design more reliable versions of Simon tasks, perhaps by presenting approach-alcohol and avoid-alcohol trials in different sub-blocks, although this would create additional interpretation problems.

Finally, we note one additional limitation of our study, which is that our sample were fairly heavy drinkers (86% scored above 8 on the AUDIT, indicating hazardous drinking), therefore light, non-problem drinkers were underrepresented. Future studies of this type should aim to recruit matched samples of heavy and light drinkers, as this may provide a more sensitive test of the relationship between automatic approach tendencies and individual differences in drinking habits.

In summary, we found that heavy drinkers, but not light drinkers, were faster to approach rather than avoid alcohol-related pictures when required to categorise those pictures on the basis of their alcohol-relatedness during an R-SRC task. This effect was not seen in a Simon task in which participants had to categorise the same pictures on the basis of an irrelevant feature.

Footnote

1. In previous papers, this type of task was referred to as the SRC task. We added the qualifier "relevant" to the name because the R-SRC task is just one of many different types of task that capitalize on stimulus-response compatibility effects (see De Houwer, 2003; Kornblum, Hasbroucq, & Osman, 1990). What is unique about the R-SRC task is that the feature that is compatible or incompatible with the response, is relevant for determining the correct response (Type II compatibility in terms of the Kornblum et al. taxonomy of SRC tasks). The Simon task, for instance, is also a type of SRC task but one in which the response (in)compatible feature is irrelevant for the task (Type III compatibility in terms of the Kornblum et al. taxonomy).

2. We also investigated split-half reliability of the Simon task by (a) considering response latencies to alcohol pictures only, and disregarding responses to control pictures, and (b) considering response latencies during the first block of the Simon task only, that is, before stimulus-response assignments were switched (half of the participants completed the approach portrait / avoid landscape block before the approach landscape / avoid portrait block; the other half of participants completed these blocks in the reverse order). Neither of these alternative methods led to an improvement in split-half reliability of the Simon task (ps > .1). In addition, neither of these alternative methods of computing the approach bias index from the Simon task led to an improvement in the correlation with individual differences in weekly alcohol consumption (ps > .1).

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Figure 1: Latencies to approach and avoid alcohol-related pictures during the relevant

stimulus-response compatibility (R-SRC) and Simon tasks, shown separately for heavy

drinkers (top panel) and light drinkers (bottom panel). Values are mean ± SEM