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Current forms of inhibitory training produce no greater reduction in drinking than simple assessment: A preliminary study

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ABSTRACT

Background: Disinhibition is apparent in users of many substances, including heavy drinkers. Previous research has shown that brief training to improve inhibitory control is associated with reduced alcohol consumption. We investigated whether a new form of inhibitory training would produce greater reductions, relative to a carefully designed control condition and a proven method of reducing consumption, the Brief Alcohol Intervention (BAI).
Methods: One hundred and fourteen regular drinkers were assigned randomly to one of five training conditions: Control (no inhibitory training); Beer-NoGo (inhibit responses linked to task-irrelevant pictures of beer); Restrained-Stop (requiring more urgent inhibition but without pictures of beer); Combined (a previously untested form of training requiring urgent inhibition to pictures of beer); or BAI. The outcome measures were alcohol consumption in the week before and after training, and in a bogus taste test administered immediately post-training.
Results: Participation in the study, regardless of condition, was associated with reductions in weekly consumption. However, only the BAI produced a greater reduction relative to the Control condition. The training tasks were not associated with reductions in taste test consumption.
Conclusions: Although concerns about low power limit confidence, the current study suggests that three forms of inhibitory training do not have a substantial effect on drinking beyond the effect of simple assessment, in comparison to a control task which does not promote impulsive responding. Future research needs to establish a training protocol that produces greater reductions in consumption not only relative to the effect of assessment but also relative to a BAI.

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1. Introduction

Inhibition is the ability to withhold, stop, or delay an inappropriate response (Barkley, 1997; Diamond, 2013); the cessation of an immediate response allows time for other important psychological processes to evaluate the situation, and select and execute a more appropriate response (Barkley, 1997). Deficits in inhibitory control feature prominently in new models of the development, maintenance, and relapse of substance use disorders (e.g., Hester et al., 2010; Jentsch and Pennington, 2014), and failures of control are implicated in DSM-5 criteria involving using a substance more, or more often, than intended, and consistently failed efforts to limit use (American Psychiatric Association, 2013). Inhibition deficits have been confirmed experimentally in users of a range of substances including not only alcohol dependence, but also heavy drinkers (reviewed in Smith et al., 2014).

If it is accepted that an inhibitory deficit is associated with undesirable and/or risky behaviours in these disorders, then the corollary is that training to improve this deficit may decrease these behaviours. Several studies have examined whether alcohol consumption in social drinkers can be reduced with training on an inhibitory task such as the Go/NoGo or Stop-Signal task. In several studies using a modified version of the Go/NoGo task (Bowley et al., 2013; Houben et al., 2011, 2012), the letters P and F, each 50%, were superimposed on images of beer and water. For half the participants, the beer image was paired with the Go stimulus (requiring a fast button press response, "Beer-Go" condition), while for the other half, the beer image was paired with the NoGo stimulus (requiring the response to be withheld, "Beer-NoGo" condition). Although the images were irrelevant to the task (i.e., the

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instructions focused on making or withholding responses to the letter stimuli), consistent pairing of the beer image with response inhibition should increase inhibitory control over beer stimuli (that is, should train direct associations between alcohol cues and stopping; Best et al., 2016; Bowditch et al., 2016). Indeed, participants in the Beer-NoGo condition decreased their consumption of alcohol in the week after compared to the week before inhibitory training (Houben et al., 2011, 2012; but see Bowley et al., 2013 for no effect). Some studies additionally use a bogus taste test to measure immediate alcohol consumption (for a review see Jones et al., 2016a). Here, participants are presented with a known amount of alcohol and asked to consume as much or as little as desired in order to rate the drink on several dimensions. The participant is not aware that the experimenter will later measure the amount of alcohol consumed. Training on the Beer-NoGo task is associated with a trend to reduced alcohol consumption in the taste test (Bowley et al., 2013; Houben et al., 2011). Inhibitory control training has also been studied in relation to other health behaviours such as food choices; across domains, the effect size for Go/NoGo tasks has been confirmed to be medium-sized and robust by two recent independently conducted meta-analytic reviews (Allom et al., 2016: 0.50; Jones et al., 2016b: 0.47).

The Stop-Signal task can also be used to assess inhibition; in this task, fast choice responses are required to two primary stimuli (e.g., respond with the left or right hand) and the occasional presentation of a stop-signal indicates the participant should interrupt the button press response (Logan and Cowan, 1984; Logan et al., 1984). In studies linking performance of a Stop-Signal task with subsequent alcohol consumption (Jones et al., 2011a,b), participants were instructed to be especially restrained (i.e., successful inhibition was emphasized over fast responding) or disinhibited (i.e., fast responding was emphasized over successful inhibition). After training, participants in the restrained condition consumed less alcohol in the bogus taste test (Jones et al., 2011a,b), but those studies did not examine changes in weekly alcohol consumption. A different variation on the Stop-Signal task was tested by Jones and Field (2013), in which alcohol-related or neutral pictures served as the Go stimuli, and, for different conditions, 90% of stop-signals occurred on alcohol trials (alcohol restraint condition) or on neutral picture trials (neutral restraint condition). A third group were instructed to ignore the stop-signal and respond to all pictures (disinhibited condition). In the bogus taste test, participants in the alcohol restraint condition drank less beer than the neutral and disinhibited conditions, which did not differ; weekly consumption was unaffected. Thus, inhibitory training appears to alter alcohol consumption measured both via an immediate taste test, and in standard drinks per week before and after the experimental session (although not all studies report reductions in weekly consumption: Bartsch et al., 2016). Recent meta-analyses have estimated the effect size for Stop-Signal tasks to be robust, albeit smaller than that for Go/NoGo tasks (Allom et al., 2016: 0.26; Jones et al., 2016b: 0.23). Two explanations are possible for the smaller effect: one is that, at least for the early versions of inhibitory training using the Stop-Signal task (Jones et al., 2011a,b), the task does not associatively link alcohol with inhibition, despite alteration of associations being a principle of cognitive bias modification (MacLeod and Grafton, 2016). Secondly, Jones et al. (2016b) argued that the smaller effect in the Stop-Signal task is due to the fact that these tasks typically involve about 50% failed inhibitions, and that appetitive cues need to be reliably paired with *successful* inhibition in order for inhibitory training to reduce alcohol consumption (Jones et al., 2016b).

In the current study, we improve upon the previous research in three respects. The first relates to the control conditions to which the inhibitory training conditions are compared, and how the selection of the control condition may alter the results observed. For the Beer-NoGo task, consumption is often compared to the Beer-Go task, in which alcohol is paired with response execution (Bowley et al., 2013; Houben et al., 2011, 2012). It could be argued that such pairing of alcohol with fast responses may lead to impulsive responding and therefore greater alcohol consumption in the taste test. Thus, for the taste test, it is not clear whether differences between Beer-NoGo and Beer-Go conditions represent low consumption in the Beer-NoGo condition, or high consumption in the Beer-Go condition (or both). Indeed, the interaction between time and condition for weekly consumption is at least partly due to an increase in consumption for the Beer-Go condition in Houben et al. (2011), and a similar, although not significant, pattern was observed in Houben et al. (2012). Similarly, for Jones et al. (2011b), performance in the Restrained condition was compared with the Disinhibited condition, and thus it is difficult to interpret taste test differences between the conditions in that study also. In a subsequent study (Jones et al., 2011a), a Control condition was included which received the usual Stop-Signal task instructions (to balance speed and accuracy); results indicated that participants in the Restrained condition consumed less beer in the taste test than the Control and Disinhibited conditions, which did not differ. This is the clearest evidence of inhibitory training producing a reduction in alcohol consumption, yet the Stop-Signal task even with standard instructions still requires (and therefore trains) inhibition. In the current study we include a Control condition, involving a task with similar stimuli requiring attention, discrimination, and a motor response; however, Go stimuli are 25% of trials in the Control task. This means that the prepotent response (on NoGo trials, 75%) is to do nothing, and only activate a response occasionally. Thus, the Control task here cannot be said to require inhibition, but nor would it favour impulsive responding; furthermore, the task uses neutral (non-alcohol-related) stimuli. However, more importantly, our Control condition allows us to examine the effect of assessment alone on alcohol consumption. Known as subject reactivity, or the Hawthorne effect, changes in a behavior simply due to observation of that behavior were first described in 1933 (Mayo, 1933); demonstrations of reductions in alcohol consumption due to assessment have been noted since 1974 (Bartsch et al., 2016; Gallen, 1974; Kypri et al., 2007; McCambridge and Day, 2008; McCambridge and Kypri, 2011; see Clifford and Maisto, 2000, for a review). Not only have the Beer-NoGo and Restrained-Stop conditions been improperly compared to conditions which increase drinking, but the treatment effect of these interventions has so far been confounded with the assessment effect. Participants in the Control condition are expected to reduce their drinking in the week after compared to the week before taking part in the experiment (due to an effect of assessment); participants in conditions which perform an inhibitory training task must therefore decrease their consumption significantly more than those in the Control condition, in order for the inhibitory task to be considered an effective intervention.

Secondly, we also consider the effectiveness of inhibitory training relative to an established method of reducing consumption, namely a Brief Alcohol Intervention (BAI), which consists of questions about and motivational feedback concerning alcohol consumption. Meta-analytic reviews confirm BAIs are effective at reducing consumption (e.g., Bertholet et al., 2005); they are also effective within the specific target population of this study (i.e., university students; Kypri et al., 2009; Samson and Tanner-Smith, 2015). BAIs can easily reach large samples via the internet; although the inhibitory tasks above could theoretically be delivered online (Jones et al., 2014), in the studies cited above, participants have completed the sessions in the laboratory. In order to justify the extra time and effort associated with laboratory testing, inhibitory tasks should also be at least as effective as a BAI at reducing alcohol consumption. Indeed, Bowley et al. (2013) report that the BAI and Beer-NoGo conditions did not differ at taste test; participants