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Facing temptation in the bar: counteracting the effects of self-control failure on young adults' *ad libitum* alcohol intake

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ABSTRACT

Background and Aims The self-control strength model suggests that exertion of self-control leads to poorer subsequent self-control performance. Failure of self-control has been suggested as an important underlying mechanism of excessive drinking. This study tested the effects of self-control failure on *ad libitum* drinking, and the potential moderating role of glucose and self-awareness on this relationship. **Design** The current research examined in two experiments whether the effects of self-control failure were different for males and females, and whether glucose (experiment 1) and self-awareness (experiment 2) would counteract the effects of self-control failure. A between-participants design with four conditions was employed in each experiment. **Setting** A semi-naturalistic drinking setting in the form of a laboratory bar. **Participants** Undergraduate students recruited at Radboud University Nijmegen, the Netherlands (experiment 1: $n = 106$; experiment 2: $n = 108$). **Measurements** The total amount of alcohol consumed during an experimental break (observational data) and questionnaire data on drinking patterns. **Findings** Self-control failure led to increased levels of drinking in males ($P < 0.05$), whereas females drank less after being depleted ($P < 0.01$). Self-awareness, but not glucose, was found to counteract the effects of self-control failure among males ($P < 0.05$). **Conclusions** Self-control failure leads to increased drinking of alcohol in males and decreased levels of drinking alcohol in females. However, increasing self-awareness appears to be a promising strategy in facing the temptation to drink when cognitive resources to inhibit intake are low.

Keywords Alcohol, bar laboratory, ego depletion, glucose, self-awareness, self-control, young adults.

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INTRODUCTION

Self-control embodies the capacity to override, interrupt or alter one's responses with respect to emotions, thoughts, attention and performance, and has been found to have implications for a wide range of behaviour patterns. As such, it is considered a key construct in successful functioning in daily life [1,2]. Whereas trait self-control is considered to be a more abstract and general capacity to self-regulate, the self-control strength model suggests that exertion of state self-control leads to poorer subsequent self-control performance, because it draws upon a limited resource of energy that is necessary for the success of self-control [1–3]. Once this strength is exerted, individuals are lower in strength and remain so for some time [4]. One specific area in which self-control failure is evident is in the regulation of alcohol intake [5,6]. When self-control functions well people are more able to control their drinking, whereas they are more likely to engage in excessive drinking when their ability to exert self-control fails [7]. Muraven and colleagues found that participants who had exerted self-control by suppressing their thoughts drank more than participants who had not exerted self-control. In another study, these authors showed that underage social drinkers tended to drink more on days on which their self-control demands

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were exerted [4]. Finally, Christiansen and colleagues [8] found that participants who had depleted self-regulatory energy drank more than non-depleted participants, despite the financial incentive that was promised to them if they refrained from drinking.

Recently, there has been increasing interest in whether the effects of self-control failure can be counteracted. Blood glucose has been suggested to be an important part of the energy source of self-control, whereby controlled and executive processes require more glucose than automatic and impulsive processes [9,10]. This suggests that self-control failure might be explained by reduced glucose levels, whereby the initial act of self-control depletes glucose needed for future attempts at self-control, leading eventually to general impaired self-control efforts. Gailliot and colleagues [11] found support for the idea that relatively small acts of self-control are sufficient to deplete the supply of glucose, with self-control failures more likely to occur when glucose is low. Furthermore, they demonstrated that restoring glucose levels by drinking a glucose drink might eliminate impaired performance on a self-control task.

Self-awareness has been suggested as another factor that could counteract the effects of self-control failure [12]. In regulating behaviour, monitoring is an indispensable component [13]. It increases consciousness, in turn making it easier to change one's behaviour. Indeed, Alberts and colleagues [14] demonstrated that individuals' performance on a physical self-control task decreased after being depleted, whereas no decrease in performance was shown when individuals were more self-aware.

The two experiments reported here were designed to test the effect of self-control failure on alcohol intake. Before concentrating on the earlier described potential moderators (i.e. glucose and self-awareness), we tested whether or not there would be differences in response to self-control failure between males and females. Not only are females less likely to have characteristics that are associated with alcohol use (e.g. behavioural under-control), the consequences of alcohol intake are also more negative for females [15]. Consequently, the natural tendency to drink is likely to be higher in males than in females and self-control failure is more likely to trigger drinking in males than in females.

It was hypothesized that participants who had depleted self-regulatory energy would drink more than non-depleted individuals. Secondly, based on the idea that the natural tendency to drink is higher in males than in females, we expected the effects of self-control failure to be stronger in males. Thirdly, based on the notion that glucose might restore self-control, we expected that depleted participants who had received a glucose drink would drink less than those who had not received a glucose drink (experiment 1). Finally, it was hypothesized that increasing participants' self-awareness regarding one's alcohol intake would override the effects of self-control failure on alcohol intake (experiment 2).

METHODS

Procedure

To increase ecological validity and minimize demand characteristics, we used the bar laboratory of Radboud University Nijmegen [16]. This laboratory is furnished as an ordinary small pub. Data collection took place on weekdays between 4 and 9 p.m. Each experimental session lasted approximately 1 hour. Participants in both experiments were undergraduates, recruited through an internet sign-up program of the Behavioural Science Institute (BSI). To increase the likelihood that participants would drink, we invited same-sex dyads of friends. Both individuals received course credits or €10 for their participation. The Institutional Review Board of the Faculty of Social Sciences of Radboud University Nijmegen approved all procedures involving human subjects. Written informed consent was obtained from all subjects.

A cover story was used to prevent participants from becoming aware of the primary aim of the experiments. First, both participants were asked to complete a questionnaire with questions about demographics, daily activities and plans for the coming hours. In addition, as a control measure, they were asked for their subjective craving for alcohol and trait self-control. These questions were embedded between filler items in order to further distract participants from the true aim of the study. After completing questionnaires containing demographic questions, the dyads were allocated randomly to the depletion or control condition. The depletion condition involved both participants completing the 'crossing out letter task' [17]. First, participants are instructed to cross out each occurrence of the letter 'e' within 5 minutes. Subsequently, they receive another page of text in which they again have to cross out the 'e', but not if this letter is followed by a vowel or embedded in a word in which a vowel appears two letters earlier. This protocol ensures that participants must suppress the inclination to cross out every letter 'e'. The crossing-out letter task has been shown to impair subsequent performance or activities that demand self-control with medium to large effect sizes [5]. Participants in the control condition conducted the simple version of the task, without complex rules, twice. Each task took approximately 10 minutes.

Subsequently, there was a break in which both participants were asked to sit down at the bar and could help themselves to drinks from the fridge. They could choose between either alcoholic (i.e. beer and wine) and non-

alcoholic drinks (i.e. sodas) in 25 cl bottles. During the break, the experimenter observed and coded the drinking behaviour in an observation room adjacent to the laboratory. After exactly 30 minutes the experimenter returned to the laboratory to ask participants to complete a final set of questions regarding their impression of the break and their drinking behaviour both during the break and in general. After completion, they were thanked for their participation. Participants who had more than two alcoholic beverages were offered a taxi home, but none of them made use of this service.

Measures

Subjective craving for alcohol

To control for participants' urge to drink during the break, momentary self-reported craving for alcohol was assessed with a 10 cm visual analogue scale (VAS), ranging from 0 (no urge at all) to 10 (very high urge to drink alcohol) [18].

Weekly alcohol consumption

To control for participants' normal drinking patterns, weekly alcohol consumption was measured with one single item: 'On which of the past seven days did you drink alcohol, and if so, how many drinks did you consume?'. The average weekly alcohol consumption was used in the analyses [19].

Trait self-control

To assess participants' trait self-control, a shortened version of the self-control scale developed by Tangney, Baumeister & Boone was employed [20,21]. This self-control scale aims to assess people's ability to control their impulses, alter their emotions and thoughts and to interrupt undesired behavioural tendencies and refrain from acting on them. The scale consisted of 11 items on a five-point scale, ranging from 1 'not at all' to 5 'very much'. Participants were asked to indicate the extent to which items applied to them. An example of an item is: 'I have hard time breaking bad habits'. Cronbach's alpha for this scale was 0.74.

Alcohol intake during the break

Participants' alcohol intake was measured by counting the number of bottles and the amount of millilitres consumed. Millilitres of unfinished drinks were subtracted from the total content of the bottle of beer or wine. The dependent variable was the total amount of millilitres alcohol (from either beer or wine) consumed.

Strategy for analysis

Because participants' alcohol intake during the break was nested within dyads, linear regression analysis was applied for answering the main question using Mplus version 5.1 [22]. To correct for the potential non-independence of the data, the TYPE=COMPLEX command was used. By means of this command, the estimation procedure corrects the standard errors of the parameter estimates for dependency, leading to unbiased estimates [23]. In each experiment, first the main effects of self-control failure and the potential moderator on participants' alcohol intake were tested. In the second step, interaction terms were included (i.e. self-control failure × glucose in experiment 1 and self-control failure × self-awareness in experiment 2). Participants' average weekly alcohol consumption, subjective craving and trait self-control were entered into the model as covariates.

EXPERIMENT 1

Method

Participants

The sample of experiment 1 consisted of 53 same-sex dyads (27 female dyads, 26 male dyads, total $n = 106$). The mean age of the participants was 20.99 years [standard deviation (SD) = 2.17].

Procedure

After completing the depletion or control task, both participants were asked to taste-test a cup of theine free tea containing 300 ml water and 35 g of glucose (glucose condition) or tea with artificial sweetener matched for the sweetness of the glucose drink (control condition). To ensure that the body could metabolize the glucose, there was a 10-minute interval between the taste-test and the start of the break [24].

Results and discussion

Individual characteristics

Participants did not differ in sex, age, weekly alcohol consumption and trait self-control across conditions. Participants' subjective craving for alcohol, however, was higher in the control task–glucose condition than in the other conditions ($P < 0.01$). Table 1 displays the participants' characteristics across the conditions.

As expected, males drank more than females during the break ($t_{(118)} = 7.67$, $P = 0.00$, males = 356 ml females = 89 ml). In addition, a significant interaction was found between sex and condition ($B = -0.52$, $P < 0.001$), indicating that males and females' alcohol intake was affected differently by the self-control manipulation. Therefore, further analyses were conducted separately for males and females.

Table 1 Descriptive statistics experiment 1 ($n = 106$): means and standard deviations (SD).

Independent variables	*Depletion—glucose*	*Depletion–control*	*Control—glucose*	*Control–control*
Age	21.57 (2.40)	20.61 (1.95)	20.50 (2.11)	21.20 (2.08)
Average use per week (glasses)	7.67 (5.71)	6.21 (4.16)	7.50 (4.32)	5.46 (5.00)
Craving	2.79 (2.55)	2.22 (2.74)	4.29 (2.71)*	1.81 (2.44)
Trait self-control	2.88 (0.48)	2.99 (0.55)	2.88 (0.66)	3.16 (0.50)

*Levels of craving in the control–glucose condition were significantly higher than craving levels in the control–control condition and the control–depletion condition ($P = 0.01$).

Table 2 Experiment 1: linear regression with alcohol intake in millimetres as dependent variable.

		Males				*Females*			
Independent variables		*Beta*	*SE*	*P-value*	*5% CI*	*Beta*	*SE*	*P-value*	*5% CI*
Step 1	Average use per week	0.13	0.15	0.39	–0.16–0.41	0.26	0.10	0.01	0.08–0.45
	Craving	0.19	0.14	0.17	–0.08–0.46	0.32	0.13	0.02	0.06–0.57
	Trait self-control	0.09	0.15	0.52	–0.19–0.38	–0.01	0.15	0.96	–0.31–0.29
	Self-control depletion condition	0.36	0.14	0.01	0.09–0.62	–0.45	0.13	0.00	–0.71–-0.19
	Glucose condition	0.29	0.14	0.04	0.01–0.57	–0.15	0.12	0.22	–0.40–0.09
Step 2	Glucose × self-control depletion	–0.01	0.25	0.98	–0.50–0.49	0.10	0.26	0.70	–0.41–0.61

SE = standard error; CI = confidence interval.

Table 2 shows the results of the linear regression analysis predicting alcohol intake in millilitres by the different conditions (controlled for weekly alcohol consumption, subjective craving and trait self-control).

For males, both self-control failure ($B = 0.36$, $P < 0.05$) and glucose administration ($B = 0.29$, $P < 0.05$) were found to increase alcohol intake. Depleted males drank more (mean = 457.29, SD = 274.13) than non-depleted males (mean = 276.46, SD = 182.94), and males who had a glucose drink drank more (mean = 453.27, SD = 250.35) than those who had a control drink (mean = 294.39, SD = 230.32). No interaction was found between self-control failure and glucose administration.

In contrast to males, females showed lower levels of alcohol intake when they were depleted ($B = –0.45$, $P < 0.01$). Depleted females drank 61.62 mm of alcohol (SD = 11.25), whereas non-depleted females drank more than twice as much (mean = 154.69; SD = 120.69). Neither the glucose manipulation nor the interaction between self-control failure and glucose administration affected females' alcohol intake.

Consistent with our hypotheses, self-control failure led to greater alcohol intake. However, this effect was found only for males. For females, self-control failure led to lower alcohol intake. As mentioned previously, females are less likely than males to carry characteristics that are associated with alcohol use, such as behavioural under-control and sensation-seeking [15]. The lack of these characteristics, in combination with the fact that females suffer from the negative proximal consequences (e.g. effects on cognitive and motor functioning) earlier and to a greater degree than males, may have led to the finding that females drink less, instead of more, when ego-depleted. As Strack & Deutsch argue [25], human behaviour can be conceptualized as initiated by impulsive behavioural tendencies and regulated by deliberate and reflective processes. Thus, in males, because of the presence of characteristics associated with alcohol use and higher tolerance to alcohol, the natural tendency may be to drink and self-control failure is likely to instigate drinking automatically. In females, because of the more negative aspects related to alcohol use, the natural tendency is not to drink or at least to stay in control, leading to less drinking when self-control fails.

Although previous studies found support for the idea that self-control can be replenished by administration of glucose [11], this study shows first indications that this theory may not apply to alcohol intake. Among males it was found that those who received glucose before the break drank more than those who did not receive glucose. A potential explanation may be that glucose had a stimulating effect on males, making them even more able and willing to consume alcohol. The finding that glucose had no effects on female drinking could be explained by the fact that alcohol consumption is not a natural tendency

for females [15]. As a consequence, any physical response in response to sudden glucose administration does not automatically cause a change in alcohol use.

EXPERIMENT 2

Method

Participants

As experiment 1 showed that self-control failure led to increased alcohol intake only in males, we chose to include only male dyads. One hundred and eight male undergraduates participated (i.e. 54 dyads). The participants' mean age was 21.73 years (SD = 2.64).

Procedure

Directly after completing the depletion or control task, both participants were assigned to one of both self-awareness conditions in which participants were either asked to keep track of their drinks on a paper note (awareness condition) or were given no instructions regarding their alcohol intake (control condition). Participants in the awareness condition were told that they had to keep track of their drinks, because this was required for us to be refunded by the institute.

Results and discussion

Individual characteristics

No significant differences in age, weekly alcohol consumption, craving and trait self-control were found across conditions. Table 3 displays the participants' characteristics across conditions.

Table 4 shows the results of the linear regression analysis predicting alcohol intake in millilitres by the main effects and interaction effect of self-control depletion and self-awareness.

Self-awareness was found to influence alcohol intake during the break ($B = -0.23$, $P = 0.05$). Participants who kept track of their drinks drank significantly less than those who were given no instructions. No main effect of self-control depletion was found. These effects, however, were qualified by a significant interaction between self-control depletion and self-awareness ($B = -0.36$, $P = 0.04$). As expected, depleted males drank significantly less when they were asked to keep track of their drinks, whereas they drank more when their self-control was replenished but were given no instructions regarding their intake (see Fig. 1).

The present experiment showed that self-control failure is related to higher levels of alcohol intake in males and that increasing self-awareness could counteract these effects. The self-awareness manipulation might have contributed to a state of increased self-evaluation that alters the salience of internalized, social or situational standards and makes it easier to regulate one's behaviour. In a similar vein, it has been demonstrated that the effects of self-control failure on subsequent self-control performance can be moderated by motivation [5]. When sufficiently motivated, individuals can compensate for the loss of self-control resources [26], and this effect has even been found for unconscious motivation [14].

Table 3 Descriptive statistics experiment 2 ($n = 108$): means and standard deviations (SD).

Variables	*Depletion—aware*	*Depletion—control*	*Control—aware*	*Control—control*
Age	22.62 (2.58)	21.87 (3.15)	21.14 (2.17)	21.21 (2.28)
Average use per week (glasses)	9.15 (3.66)	9.38 (3.44)	7.55 (3.80)	7.25 (3.97)
Craving	3.40 (2.59)	4.07 (2.95)	3.31 (2.43)	3.49 (2.81)
Trait self-control	2.94 (0.62)	3.03 (0.60)	3.09 (0.72)	3.09 (0.57)

Table 4 Experiment 2: linear regression with alcohol intake in millimetres as dependent variable.

		Alcohol intake			
Independent variables		*Beta*	*SE*	*P-value*	*5% CI*
Step 1	Average use per week	0.18	0.08	0.02	0.03–0.33
	Craving	0.38	0.09	0.00	0.20–0.56
	Trait self-control	–0.08	0.10	0.43	–0.27–0.12
	Self-control depletion condition	–0.06	0.12	0.62	–0.28–0.17
	Self-awareness condition	–0.23	0.12	0.05	–0.46–0.00
Step 2	Self-awareness × self-control depletion	–0.36	0.18	0.04	–0.70—0.01

SE = standard error; CI = confidence interval.

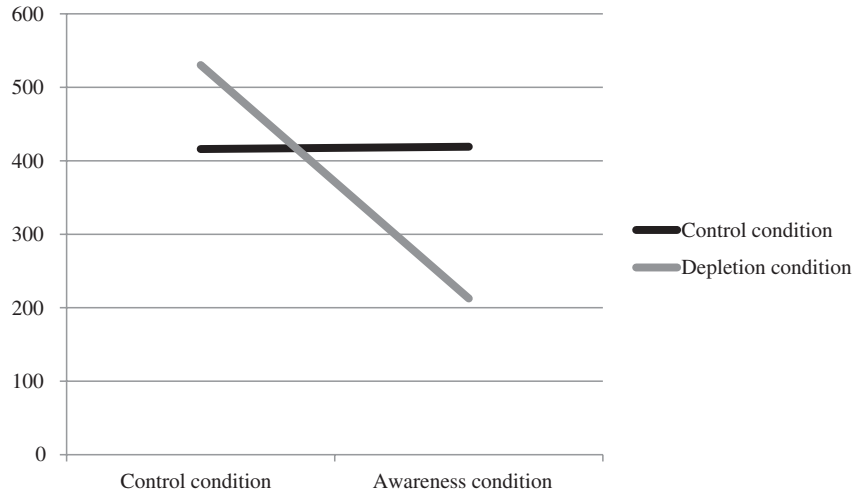

Figure 1 Interaction between self-awareness × self-control failure

Instructing participants to monitor their alcohol intake might have contributed to an increased awareness of these participants, helping them to evaluate their alcohol intake against their implicit or explicit alcohol limits, and helping them to exert self-control in spite of the loss of resources.

No effect of self-awareness was found for non-depleted participants, suggesting that increasing self-awareness is mainly beneficial when self-control resources are diminished. These results are consistent with previous research, as the majority of studies reported no effect of self-monitoring on alcohol intake [27–29].

Additionally, studies which demonstrated that motivation [26,29] and self-awareness [14] could overcome effects of self-control failure reported similar results; manipulation of motivation and self-awareness only increased the self-control performance of depleted participants. The reason why there are no effects for non-depleted participants is, as yet, unclear. It can be argued that individuals are more responsive to manipulations when self-control resources are low because they are less able to correct for environmental influences. Alternatively, the results may reflect a ceiling effect in how much effort participants are willing to invest [14]. Future studies are needed to test these explanations.

DISCUSSION

The present study demonstrated that males and females respond differently to self-control failure in a drinking context: males increase their intake, whereas women drink less when depleted. While no moderating effects were found for glucose, increasing self-awareness appeared to be a potential strategy to counteract the consequences of self-control failure on alcohol intake.

With regard to self-awareness, our findings have important implications for intervention and prevention. One of the primary goals of intervention programmes is the development of patients' capacity for self-control [30], as loss of self-control resources could heighten the risk for alcohol intake. For example, when circumstances place extra demands on self-control resources, a recovering alcoholic may be at increased risk for lapse/relapse. This may be quite common in everyday life, given that self-control strength is used every time people inhibit their impulses [1]. Finding ways to decrease this risk can improve patients' chance for successful recovery. Increasing self-awareness may be a strategy to anticipate in self-control demanding situations.

For non-problematic drinkers, as in our experiments, it is also fairly easy to devise scenarios in which limiting the consumption of alcohol is desirable, but violating (self)-imposed limits is tempting. Because drinking alcohol is deeply ingrained in our culture, equipping people with the ability to self-regulate alcohol intake seems a challenging approach [31]. Acknowledging the importance of self-awareness in alcohol use, Baumeister, Schmeichel & Vohs suggested prohibiting bartenders and other servers from removing empty glasses, thereby increasing self-awareness [13]. Indeed, empty glasses would furnish a clear tally of the number of drinks consumed, although perhaps our strategy (keeping track of your own drinks) may be somewhat more subtle. Nevertheless, there is a need for studies that introduce more creative ways of contributing to increased awareness of alcohol intake in drinking contexts.

This study is not without limitations. First, while self-awareness was found to have an inhibiting effect on drinking behaviour, it is still unknown whether or not this effect may be subscribed to motivation processes [32], implementation intentions [26] or merely a form of reactivity whereby participants modified their drinking behaviour because they were aware that their intake was observed. Testing the underlying processes of the link

between self-control and self-awareness would be a valuable addition to this research field. Secondly, most of our participants were highly educated students. Self-control is an important element of executive functioning [33], and there is a positive relationship between education and performance of executive functioning [34]. Therefore, our participants might have higher than average levels of self-control and the effects of self-control failure might be even stronger in lower-educated individuals. Future research should reveal whether findings could be generalized to other samples. Thirdly, participants' drinking behaviour was observed within a limited time-frame. Although this period was long enough to identify differences in intake between groups, it is likely that if this period had been longer, effects might have cumulated or diminished. It has been stated that alcohol intake affects the interplay between automatic and controlled processes, the same underlying processes that are assumed to explain effects of self-control failure [35]. Consumption of alcohol is associated with an increase in the effectiveness of automatic processes and a decrease in the effectiveness of controlled processes, thereby potentially reducing the moderating effect of self-awareness. However, another possibility is that increased self-awareness makes people drink less and not reach the threshold for fading of this effect. Future research might explore these possible mechanisms. Fourthly, our sample sizes in both experiments did not allow for testing whether the effects of self-control failure were different for heavy drinkers and moderate drinkers. Finally, with respect to the effects of glucose, future studies that aim at testing its potential moderating effects would benefit from more objective measures to assess the effects of blood sugar.

In conclusion, this study showed that, in a semi-natural setting, self-control failure increases alcohol consumption in males. Moreover, it showed that self-awareness might have the potential to counteract the effects of self-control failure. Although future experimental research on the link between self-control failure and alcohol intake is warranted, increasing self-awareness by keeping track of the drinks may be a promising strategy to reduce problem drinking.

Declaration of interests

None.

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