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Resisting chocolate temptation using a brief mindfulness strategy

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Objectives. We examined the effects of two mindfulness-based strategies on chocolate consumption amongst individuals who were trying to reduce the amount of chocolate they consumed.

Methods. Participants (n = 137) were allocated to one of three conditions and employed either cognitive defusion, acceptance, or relaxation (control) techniques to help them resist chocolate over 5 days. During this period, they carried a bag of chocolates with them and recorded any chocolate or chocolate-related products they consumed. They also completed a questionnaire measure of the extent to which chocolate consumption was automatic, both before and after the 5-day period.

Results. Results showed that compared to controls, those in the cognitive defusion group ate significantly less chocolate from the bag (p = .046) and less chocolate according to the diary measure (p = .053). There was evidence that these changes were brought about by reductions in the extent to which chocolate consumption was automatic. There were no differences in chocolate consumption between the acceptance and control groups.

Conclusions. Our results point to a promising brief intervention strategy and highlight the importance of disentangling the effects of different mindfulness-based techniques.

Statement of contribution

What is already known on this subject?

- Multicomponent mindfulness interventions have been successfully applied to a range of health behaviours.
- Low levels of self-control are associated with weight gain and a higher BMI.

What does this study add?

- The results show that a brief mindfulness strategy (defusion) helps individuals resist chocolate over 5 days.
- The results suggest this may be brought about by reductions in the extent to which eating chocolate is automatic.
- A second brief mindfulness strategy (acceptance) failed to help individuals resist chocolate.

Mindfulness is 'awareness that emerges through paying attention on purpose, in the present moment, and non-judgementally to the unfolding of experience moment by

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moment' (Kabat-Zinn, 2003, p. 145). Mindfulness-based therapies are increasingly being successfully applied to health-related issues and behaviours, in areas ranging from symptom management, depression, and binge eating to smoking cessation, drug abuse, and weight loss (Davis, Fleming, Bonus, & Baker, 2007; Gayner *et al.*, 2012; Gifford *et al.*, 2004; Hofmann, Sawyer, Witt, & Oh, 2010; Kristeller & Hallett, 1999; Tapper *et al.*, 2009; Teasdale *et al.*, 2000). For example, Gifford *et al.* (2004) found higher levels of smoking abstinence at 1-year follow-up amongst individuals who had completed a mindfulness-based programme compared to those who had received nicotine replacement therapy. Similarly, Tapper *et al.* (2009) found that compared to controls, participants who were still employing mindfulness techniques 6 months after a mindfulness-based weight loss programme showed reductions in BMI and increased levels of physical activity. However, in keeping with other mindfulness interventions, the above programmes employed a range of different components making it difficult to isolate the mechanisms of action or specific techniques that account for improvements (Hölzel *et al.*, 2011).

The current study examined two mindfulness-based strategies, *cognitive defusion* and *acceptance* (Hayes, Strosahl, & Wilson, 1999). Cognitive defusion encourages individuals to change the way they relate to their thoughts, for example to see their thoughts as 'merely thoughts' rather than as statements of fact. This differs from cognitive restructuring in which individuals are asked to challenge their thoughts and replace them with alternative thoughts. In cognitive defusion, the individual is not asked to change their thoughts in any way, but may instead be asked to simply notice their thoughts and to visualize themselves as different from their thoughts. In this way, the individual is encouraged to create a mental distance both between themselves and their thoughts, and between their thoughts and reality. Acceptance promotes acceptance of difficult feelings (and thoughts), again without the need to change or control them. For example, the individual may be encouraged to simply observe their feelings, and accept their presence, rather than try to control or eliminate them. As such, the individual is encouraged to build up a degree of tolerance for uncomfortable feelings. Although there is some overlap between these two techniques, cognitive defusion can be viewed as a strategy that aims to change the way in which difficult thoughts are viewed, whilst acceptance is more concerned with promoting a willingness to experience uncomfortable internal events. In the present study, in order to further enhance the difference between these techniques, we also restrict the use of the acceptance strategy to feelings (rather than thoughts and feelings). Ultimately however, the aim of both techniques is to enable individuals to pursue their goals, *despite* any difficult thoughts or feelings.

We examined these two techniques in relation to a health-related behaviour that requires self-control, resisting chocolate. We chose chocolate because most individuals report great liking for chocolate and it is also a food that elicits strong cravings (e.g., Rozin, Levine, & Stoess, 1991). The ability to exercise self-control is particularly important for health-related behaviours that may have immediate rewards but delayed negative consequences, such as smoking, binge drinking, and eating an unhealthy or high-calorie diet. Indeed, high levels of self-control have been shown to protect against overweight (Tsukayama, Toomey, Faith, & Duckworth, 2010), whilst low levels are a factor associated with weight gain and higher BMIs (Lawrence, Hinton, Parkinson, & Lawrence, 2012; Nederkoorn, Houben, Hofmann, Roefs, & Jansen, 2010). In this study, we took the example of chocolate consumption and examined the extent to which cognitive defusion and acceptance techniques could assist those who were attempting to exercise self-control in order to reduce the amount of chocolate they ate. Previous studies have found that mindfulness-based techniques can help reduce food cravings

amongst certain subgroups of individuals (i.e., individuals who are overweight or obese, display disordered eating behaviours, or have a high susceptibility to the presence of food cues; Alberts, Mulkens, Smeets, & Thewissen, 2010; Alberts, Thewissen, & Raes, 2012; Forman *et al.*, 2007) and reduce the number of chocolates consumed in the laboratory following a period of abstinence (i.e., behavioural rebound; Hooper, Sandoz, Ashton, Clarke, & McHugh, 2012). More recently, Moffitt, Brinkworth, Noakes, and Mohr (2012) compared the effects of cognitive defusion and cognitive restructuring techniques on consumption of chocolates from a bag that participants carried with them over a 7-day period. They found that participants in the defusion group were more likely to resist the chocolates compared to participants in the restructuring group. In the current study, we compared defusion techniques with acceptance techniques and a relaxation control. Like Moffitt *et al.*, we examined effects on chocolate consumed from a bag but over a 5-, rather than 7-day period. We also asked participants to keep a diary of any other chocolate or chocolate-related products consumed in order to assess the impact on the overall amount of chocolate consumed. Given the high levels of saturated fats, sugars, and calories contained in chocolate and other palatable snack foods, any technique that can help individuals to exercise self-control in order to cut back on such foods could be beneficial for both healthy eating and weight loss interventions.

We also explored the potential mechanisms by which these techniques may bring about their effects. There is evidence to suggest that consumption of high-calorie snacks may often be habitual (e.g., Adriaanse, de Ridder, & Evers, 2011; Cleobury and Tapper, 2013; Neal, Wood, Wu, & Kurlander, 2011; Verhoeven, Adriaanse, Evers, & de Ridder, 2012). In other words, snacking is often performed with a high degree of automaticity, in response to specific environmental cues. However, we believe that the cue in many instances may be cognitive rather than environmental. For example, the individual thinks 'I need something sweet' and automatically reaches for the biscuit tin. We believe cognitive defusion strategies may work by disrupting the automatic links between such thoughts and behaviours, because the individual is prompted to engage in an alternative behaviour (noticing) in response to their thoughts, rather than snack consumption. In this study, we used the Self-Report Habits Index (SRHI; Verplanken & Orbell, 2003) as a measure of the extent to which chocolate consumption was habitual. There is evidence to indicate that the SRHI is a valid measure of habit strength and it has been shown to have high internal and test–retest reliability (Verplanken & Orbell, 2003). Because we asked participants to keep a diary of their chocolate consumption during the study period, we would anticipate seeing reductions in automaticity across the whole sample, as a result of an increased awareness of their behaviour. However, if cognitive defusion strategies do disrupt automatic links between specific thoughts and chocolate consumption, then we would expect to see greater reductions in automaticity amongst individuals who had been allocated to the cognitive defusion group.

Acceptance requires individuals to simply sit with, rather than to struggle with, uncomfortable feelings. In contrast, emotion regulation (e.g., trying to get rid of uncomfortable feelings) is thought to draw on self-regulatory resources (Muraven, Tice, & Baumeister, 1998). Self-regulatory resources will also be needed to resist chocolate. Because self-regulation is believed to be a limited resource (Muraven *et al.*, 1998), learning to accept rather than to regulate difficult emotions may result in the increased availability of self-regulatory resources for other behaviours, including resisting chocolate. Indeed, Alberts, Schneider, and Martijn (2012) found that participants who accepted their

emotions during a sad video clip performed better on a subsequent self-regulation task compared to those in a control condition. Thus, in the current study, acceptance strategies may help individuals resist chocolate by freeing up self-regulatory resources that would otherwise have been used for regulating chocolate cravings. We measured self-regulation using a handgrip task (Muraven, Baumeister, & Tice, 1999). This is a validated procedure for assessing self-regulation (Muraven *et al.*, 1998) in which participants are asked to squeeze together a handgrip for as long as possible both before and after completing another task that also requires self-regulatory resources (such as emotion regulation or resisting a tempting food). The length of time the individual can keep the handgrip squeezed together for the second time is generally less than that for the first time because they will have used up some of their self-regulatory resources during the intervening task. The extent of this reduction is taken as an indication of the amount of self-regulatory resources used up, with smaller reductions indicating reduced vulnerability to fatigue.

Finally, we tested for behavioural rebound. Behavioural rebound refers to a tendency to engage in higher levels of a behaviour following a period of abstinence. For example, binge eating has been shown to follow periods of dieting (Polivy & Herman, 1985). This is important because any dieting or healthy eating strategy that results in behavioural rebound is unlikely to be associated with long-term success. In the present study, we tested for behavioural rebound by measuring the amount of chocolate consumed by the participant in the laboratory following the period of abstinence.

To summarize, existing research suggests that mindfulness strategies may be helpful for health-related self-control behaviours, such as resisting tempting foods. However, it is less clear *which* strategies are effective, or how they bring about these effects. The current study examined the effects of two mindfulness-based strategies, cognitive defusion and acceptance, on ability to resist chocolate over a 5-day period. It also assessed the effects of these strategies on two potential mediators, automaticity and self-regulation. If cognitive defusion and acceptance strategies are effective at helping individuals resist chocolate, we would expect to see lower levels of chocolate consumption amongst these two groups, relative to a relaxation control group, over the 5-day study period. If cognitive defusion brings about these effects by reducing the extent to which chocolate is consumed automatically, we would also expect to see reductions in automaticity (as assessed by the SRHI) amongst the cognitive defusion group relative to the control group, together with positive correlations between levels of automaticity reported at follow-up and amount of chocolate consumed. Likewise, if acceptance brings about its effects by increasing the availability of self-regulatory resources (as assessed by the handgrip task), we would expect to see increases in self-regulatory ability amongst the acceptance group relative to the control group and negative correlations between self-regulatory ability at follow-up and amount of chocolate consumed. Finally, for the acceptance and cognitive defusion strategies to have applied utility, it is important they do not lead to behavioural rebound.

Method

Participants

Participants were 137 university students (98 females; mean age = 20.45 years, SD = 2.39) who responded to email and poster advertisements for individuals interested in reducing their chocolate consumption. Participants received £10 upon study

completion. The study was approved by Swansea University's Psychology Department Research Ethics Committee.

Sample size

The target sample size was 135 (45 participants per group). There were no studies directly comparable to the present research, but this figure was informed by sample sizes employed in other studies examining mindfulness-based techniques and eating behaviours (Forman *et al.*, 2007; Tapper *et al.*, 2009).

Measures

Baseline characteristics

To check that the three groups did not differ on variables that may influence chocolate consumption, details of age, gender, level of study, and diet status (i.e., dieting to lose weight vs. not dieting to lose weight) were also collected at baseline along with measures of liking for chocolate, frequency of chocolate consumption, openness (Trait Self-Description Inventory, Collis & Elshaw, 1998), and eating style (emotional eating, external eating, and restrained eating; Dutch Eating Behaviour Questionnaire, Van Strien, 2002).

Primary outcome measures: Chocolate consumption

Participants were given a transparent bag of chocolates at the end of their baseline appointment to keep in their possession at all times over the next 5 days. To make it easier for participants to eat some of the bagged chocolates, and thus reduce floor effects, they were told the bag contained 12 chocolates when in fact it contained 14. These had been surreptitiously marked to ensure that substitutions could be identified (Forman *et al.*, 2007). The bag was collected 5 days later at their follow-up appointment and the chocolates were counted. Participants were also provided with a diary at their baseline appointment and asked to record all other chocolate and chocolate-related products consumed over the 5-day period together with details of brand, size (in grams), and amount consumed (e.g., half, quarter).

Mediator measures: Self-regulation, automaticity

A handgrip task (Muraven *et al.*, 1999) was employed at both baseline and follow-up to assess self-regulation. The length of time the participant was able to squeeze together a handgrip exerciser in their dominant hand was recorded. Participants were then asked to attend to, but not eat from, a bowl of chocolates for 3 min, before squeezing together the handgrip for a second time. Self-regulation was scored by subtracting the second handgrip time from the first handgrip time, with higher scores indicating poorer self-regulation.

The extent to which chocolate consumption was automatic was assessed at baseline and follow-up using the Self-Report Habit Index (SRHI; Verplanken & Orbell, 2003). The SRHI is a 12-item measure of habit strength that taps into key features of habit (a history of repetition, lack of control and awareness, efficiency, expressing identity) using statements such as 'Eating chocolate is something I do without thinking' and 'Eating chocolate is something I start doing before I realize I'm doing it'. Each item is scored using

a 5-point response scale ranging from 1 (*disagree*) to 5 (*agree*) with higher total scores indicating greater habit strength.

Assessment of behavioural rebound

At follow-up, 25 chocolates were placed in a bowl in front of the participant who was told they had successfully completed the study, so were free to eat as many as they wished. Participants were left alone with the bowl of chocolates for 5 min whilst the experimenter went to collect their payment. Remaining chocolates were counted once the participant had been debriefed.

Process measures: Strategy adherence, task adherence, chocolate cravings, suspicion probe

Strategy adherence was assessed at follow-up by asking participants to rate the number of times they used their allocated strategy over the 5 days on a 4-point scale (1 = *not at all*, 2 = *sometimes*, 3 = *nearly always*, 4 = *always*). Task adherence was assessed at follow-up by asking participants to state whether they carried the bagged chocolates with them at virtually all times over the 5-day period using a yes/no response option. Participants were also asked at follow-up to rate the average level of distress caused by chocolate cravings over the previous 5 days, on a 5-point scale (1 = *not at all distressing,* 5 = *extremely distressing)*. As part of a suspicion probe at follow-up, participants were asked whether they thought they had been allocated to an intervention or control group.

Procedure

Baseline appointments took place on a Monday and follow-up appointments on a Friday. The 5-day period was selected to give participants a sufficient amount of time to use their strategy whilst also limiting respondent burden in terms of diary completion. We avoided using weekend days because we felt the increased variability in daily routines during the weekend may make it more difficult for participants to keep the bag of chocolates with them as well as to introduce more variability into the data. At both appointments, all tasks and exercises were administered to participants on an individual basis. Prior to attending baseline appointments, participants completed the SRHI and baseline characteristics questionnaires.

Baseline appointment

Participants were alternately allocated to one of three conditions (cognitive defusion, acceptance, and control). Participants first completed the handgrip task. They then received a handout that contained (1) the rationale behind their allocated strategy, (2) details of the strategy, (3) a practice exercise, and (4) instructions for the next 5 days.

The handout for the cognitive defusion group was titled ‘Seeing your thoughts differently’. The rationale section explained that thoughts can sometimes sabotage intentions and that in situations like these it can be helpful to think of oneself as different from one’s thoughts. The strategy section went on to describe the mindbus metaphor (i.e., viewing oneself as the driver of a bus and one’s thoughts as passengers, see Hayes & Smith, 2005; Hayes *et al.*, 1999) and gave three examples of strategies the participant could use in response to difficult ‘passengers’ (i.e., difficult thoughts; describing them,

letting them know who is in charge, making them talk with a different accent, or sing what they are saying; see Hayes & Smith, 2005; Hayes *et al.*, 1999). In the practice exercise section, participants were asked to select one of the three strategies and spend 5 min imagining themselves using it, either in response to recent difficult chocolate-related thoughts or in response to the types of difficult chocolate-related thoughts they might experience over the next 5 days. The instructions section asked participants to carry the bag of chocolates with them at all times over the next 5 days, to try to resist eating any kind of chocolate, and to use the strategy outlined in the handout whenever they were tempted to eat chocolate. In order to try to limit social desirability bias, the instructions also noted that resisting chocolate is difficult so the participant may find that they cannot always manage this. In which case, they should simply make a note of what they have eaten in their diary.

The handout for the acceptance group was titled 'Accepting our feelings'. The rationale section explained that in order to try to deal with uncomfortable feelings, we often try to control them. However, getting rid of food cravings is difficult and battling with them may result in the individual experiencing a whole range of additional, distressing thoughts, making things even more difficult. Accepting feelings was presented as an alternative. The strategy section described 'urge surfing'. Urge surfing was described as 'riding the wave' of urges or cravings, in other words, being aware of them and 'surfing' them rather than 'sinking' or giving in to them (see Marlatt, Bowen, Chawla, & Witkiewitz, 2008). In the practice exercise section, participants were asked to visualize their favourite type of chocolate in front of them and get in touch with any cravings they had to eat it. They were then asked to spend 5 min observing these feelings and employing the urge surf strategy. The instructions section was identical to that contained in the cognitive defusion handout except that participants were asked to use the urge surfing strategy.

The handout for the control group was titled 'Relaxation'. The rationale section explained that too much stress leads to health problems and could sometimes cause people to overeat by reducing their ability to resist temptation. Learning to relax was proposed as a means of counteracting stress. The strategy section described a muscle relaxation technique that involved tensing and then relaxing different groups of muscles. In the practice exercise section, participants were asked to think of a recent situation in which they had felt stressed, or to try to imagine the types of stressful events they might experience over the next 5 days. They were then asked to spend 5 min imagining this situation and practising the muscle relaxation technique in response to it. The instructions section was identical to that contained in the cognitive defusion and acceptance handouts except that participants were asked to use the muscle relaxation strategy.

The handouts for all three groups were matched, as far as possible, for length and content. Nevertheless, in order to accurately reflect the cognitive defusion and acceptance strategies, and the ways in which they tend to be used in practice, differences were inevitable. Copies of the handouts provided to participants can be obtained from the authors.

The researcher guided the participant through the handout and answered any questions. Participants then practised their technique for 5 min. The session took 20–25 min. Each participant was then given the bag of chocolates and chocolate diary together with related instructions which were outlined by the researcher.

On Thursday (i.e., 4 days after their baseline appointment), participants were emailed a link to the SRHI. They completed this before their follow-up appointment.

Follow-up appointment

Participants returned on Friday (i.e., 5 days after their baseline appointment) and completed the handgrip task, process measures, and rebound assessment.

Results

Data screening

In response to the chocolate craving distress measure, two participants reported having no chocolate cravings during the previous 5 days. Because participants were only asked to use their strategy when they were tempted to eat chocolate, these two participants would not have had an opportunity to employ their given strategy and were excluded from subsequent analyses. An additional participant had chocolates missing from the bag but stated that a housemate must have eaten them. Data for this participant were excluded from the analysis of bagged chocolate. This resulted in 135 participants for the chocolate diary measure (n = 45 in all groups) and 134 participants for the bagged chocolate measure (n = 45 in the defusion and control groups, 44 in the acceptance group). The majority of participants reported that they had carried the bag of chocolates with them 'at virtually all times' during the 5-day period (98% of participants in the control group, 93% in the cognitive defusion group, and 91% in the acceptance group). For those who reported that they had not kept the chocolates in their possession at virtually all times, the maximum length of time for which they did not have the chocolates was 8 hr. There were no significant differences in baseline characteristics across the three groups (see Table 1), with the exception of emotional eating which was significantly higher in the defusion compared to the control group. However, across all groups, levels of emotional eating showed no association with either of the two chocolate measures.

Table 1. Baseline characteristics across the defusion, acceptance, and control groups

Characteristics (scale)	Defusion (n = 45)	Acceptance (n = 45)	Control (n = 45)
Age (M, SD)[a]	20.11 (2.29)	20.58 (2.08)	20.67 (2.76)
Sex (% females)[b]	71.0	71.0	71.0
Current level of study (% undergraduates)[c]	91.0	87.0	93.0
Liking for chocolate (1–7) (median and interquartile range)[c]	7 (6.00–7.00)	7 (6.00–7.00)	7 (6.00–7.00)
Frequency of chocolate consumption (1–7) (median and interquartile range)[c]	6 (5.00–7.00)	6 (4.50–6.00)	5 (4.00–6.50)
Desire to reduce chocolate consumption (1–5) (median and interquartile range)[b]	4 (3.00–5.00)	4 (3.00–4.50)	4 (3.00–4.00)
Currently dieting (% yes)[b]	13.0	20.0	9.0
Openness (OCEAN) (1–9) (M, SD)[a]	45.38 (10.30)	42.02 (13.01)	41.07 (11.38)
DEBQ – Emotional (1–5) (M, SD)[a]	3.14 (.90)	2.95 (.92)	2.69 (.90)
DEBQ – External (1–5) (M, SD)[a]	3.60 (.62)	3.63 (.72)	3.53 (.76)
DEBQ – Restricted (1–5) (M, SD)[a]	2.66 (.87)	2.65 (.93)	2.49 (.83)

Note. Non-parametric tests were employed where Kolmogorov–Smirnov tests indicated significantly non-normal distributions. A significant difference was evident between the defusion and control groups (p = .020) for the DEBQ – emotional measure. There were no other significant differences.
[a]t-test, [b]chi-square, [c]Mann–Whitney U.

Effects on chocolate consumption

Examination of the returned bagged chocolates indicated that no chocolates had been substituted. Overall, 50 of the 135 participants consumed some form of chocolate over the 5-day period (i.e., they either ate chocolate from the bag or they had recorded eating chocolate in their diary, or they did both): 12 (27%) from the defusion group, 19 (45%) from the acceptance group, and 19 (45%) from the control group. Table 2 shows mean, maximum, and minimum levels of chocolate consumption across the three groups for the two consumption measures and for overall grams eaten. The defusion group consumed the least number of chocolates from the bag (0.02) and the least chocolate according to the diary (13.22 g). The control group consumed the greatest number of chocolates from the bag (0.69), whereas the acceptance group consumed the most chocolate according to the diary (48.22 g). A series of four Mann–Whitney *U*-tests were used to compare the two mindfulness groups with the control group for each of the two consumption measures. These showed that participants in the defusion group ate significantly less chocolate from the bag compared to those in the control group ($z = 1.998$, $p = .046$). The results also approached significance for chocolate recorded in the diary ($z = 1.933$, $p = .053$), again with participants in the defusion group consuming less than those in the control group. Differences between the acceptance and control groups were not significant (bagged chocolate, $z = .711$, $p = .477$; diary chocolate, $z = .027$, $p = .979$).

Relationships with mediators

To explore whether the reduced levels of chocolate consumption in the defusion group could be accounted for by decreased levels of automaticity (SRHI) or improved self-regulation (handgrip task), two 3 (group) × 2 (time) ANOVA tests examined group differences in mediator score change. These showed no significant interaction for the handgrip task, $F(2, 132) = 2.13$, $p = .123$, but a trend towards a significant interaction for the SRHI, $F(2, 132) = 2.80$, $p = .064$. There was also a significant main effect of time on SRHI score, $F(1, 132) = 131.59$, $p = .001$, with means indicating an overall reduction in automaticity between baseline and follow-up ($M = 3.41$, $SD = .84$ and $M = 2.33$, $SD = .98$ respectively). Follow-up *t*-tests using change scores showed significantly greater reductions in automaticity in the defusion group ($M = -1.31$, $SD = 1.14$) compared to the control group ($M = -0.78$, $SD = 1.02$), $t(88) = 2.33$, $p = .022$, but no difference between the acceptance group ($M = -1.16$, $SD = 1.13$) and the control group, $t(88) = 0.63$, $p = .53$. Across the whole sample, SRHI score at follow-up showed

Table 2. Quantity (mean, minimum, maximum) of chocolate consumed from the bag and, according to the diary measure, by participants in the defusion, acceptance, and control groups

	Chocolates from the bag (number)			Other chocolate (g)			Total grams of chocolate consumed[a]
	Mean (*SD*)	Minimum	Maximum	Mean (*SD*)	Minimum	Maximum	Mean (*SD*)
Defusion	0.02 (.15)	0.00	1.00	13.22 (30.80)	0.00	136.25	13.43 (31.28)
Acceptance	0.27 (.95)	0.00	5.00	48.22 (108.23)	0.00	567.70	51.78 (111.43)
Control	0.69 (2.08)	0.00	10.00	37.47 (68.10)	0.00	348.00	44.02 (75.56)

Note. [a]Chocolates from the bag each weighed approximately 9.5 g.

significant (Spearman's) correlations with both diary chocolate ($r = .21$, $p \leq .05$) and chocolate from the bag ($r = .20$, $p \leq .05$), indicating that lower levels of automaticity were associated with less chocolate consumption.

Behavioural rebound

Mann–Whitney *U*-tests were used to examine group differences in the number of chocolates eaten at the rebound assessment. These showed no significant differences between participants in the defusion group ($M = 2.27$, $SD = 2.96$) compared to the control group ($M = 3.80$, $SD = 4.62$; $z = 1.683$, $p = .092$), or between participants in the acceptance group ($M = 3.58$, $SD = 3.32$) compared to the control group ($z = .428$, $p = .669$). Thus, the reduced chocolate consumption in the defusion group did not appear to result in a behavioural rebound effect.

Strategy adherence and halo effects

Within the three groups, 60–80% reported using their strategy either 'nearly every time' or 'every time' they experienced a chocolate craving. Mean ratings of strategy use were significantly higher amongst those in the acceptance group, $M = 3.09$, $SD = .70$, compared to the control group, $M = 2.73$, $SD = .65$; $t(88) = 2.49$, $p = .015$. Differences between the defusion group, $M = 3.00$, $SD = .64$, and the control group approached significance, $t(88) = 1.96$, $p = .054$, but there were no significant differences between the acceptance and defusion groups, $t(88) = 0.628$, $p = .532$.

To explore possible halo effects, the proportion of participants who believed they had been allocated to an experimental group was compared across the three conditions. In the defusion group, 89% believed they had been allocated to an experimental group, 76% in the acceptance group, and 62% in the control group. Thus, whilst it is not possible to entirely rule out halo effects, had these had a significant impact one would have also expected reduced chocolate consumption in the acceptance group relative to the control group. As shown in Table 1, this was not consistently the case.

Discussion

The results showed that the cognitive defusion task significantly reduced the amount of chocolate consumed by participants outside the laboratory over a 5-day period. Importantly, consumption was measured using observation as well as self-report. These findings support those of Moffitt *et al.* (2012) who also found significantly lower levels of chocolate consumption amongst participants exposed to a 60-min group cognitive defusion intervention compared to an equivalent cognitive restructuring intervention. The current findings also extend this work by showing that, in line with other research (Hooper *et al.*, 2012), there was no evidence of behavioural rebound effects at the end of the abstinence period. Given the brevity of the intervention training in the current study, the findings are promising. We now intend to explore the extent to which these effects maintain over time and can be extended to other situations that require self-control, such as smoking cessation, alcohol consumption, and safe sex.

Our results also provide support for our hypothesis that the defusion strategy works by interrupting automatic links between specific thoughts (e.g., 'I need something sweet') and chocolate consumption, because those who employed the defusion strategy experienced greater reductions in the extent to which chocolate consumption was

automatic compared to the other two groups. Across all three groups, lower levels of automaticity at follow-up were also significantly associated with lower levels of chocolate consumption, providing further support for the view that targeting snacking automaticity may be a helpful behaviour change strategy. We are currently looking at the effects of the defusion strategy on other measures of automaticity alongside other potential mediators (strengthening links between the cue and competing goals, Neal, Wood, Labrecque, & Lally, 2012; reducing cravings by loading the visuospatial sketchpad of working memory, Kavanagh, Andrade, & May, 2005).

By contrast, despite equivalent levels of strategy adherence, those in the acceptance group failed to show a reduction in chocolate consumption relative to controls. Whilst mindfulness-based interventions have successfully influenced self-control-related health behaviours (e.g., Gifford *et al.*, 2004; Tapper *et al.*, 2009), it is unclear to what extent change is brought about by acceptance components versus other components. It is possible that in the present study, participants simply did not receive sufficient practice at this strategy to make it effective. For example, whilst Alberts *et al.* (2010) showed that a 7-week acceptance-based intervention reduced food cravings amongst overweight and obese individuals, other studies conducted over shorter periods have shown increases in food cravings in response to acceptance strategies (e.g., Hooper *et al.*, 2012). However, it is important to note that participants in the acceptance condition in the current study did not show a significant increase in chocolate consumption relative to the control group over the 5-day period. Thus, any increase in chocolate cravings experienced by this group did not appear to be associated with increased consumption. This is relevant because one of the aims of mindfulness strategies is to reduce the extent to which individuals act upon their thoughts and feelings, thus making it possible to resist chocolate *despite* cravings. Future research could explore the effects of the acceptance technique on both cravings and consumption over a longer time period.

However, an alternative interpretation is that acceptance strategies are not suitable for enhancing health-related behaviours that require self-control. One reason is that acceptance requires the participant to focus on their feelings. Paradoxically, because feelings are linked to the 'hot' stimuli the participant is trying to resist, this may actually make self-control more difficult (Metcalfe & Mischel, 1999; see also Kavanagh *et al.*, 2005). It is possible that acceptance strategies may be more helpful where the participant is trying to create new habits (e.g., participate in physical activity) rather than to break old ones (van't Riet, Sijtsema, Dagevos, & De Bruijn, 2011).

It is important to acknowledge the limitations of the current study. First, it employed a relatively short time frame (5 days). Thus, to be confident of the utility of the cognitive defusion strategy for intervention, its effects would need to be demonstrated over a longer period. Second, because the diary measure included in the study relied on self-report, it is possible that it was subject to social desirability bias. However, given participants were blind to group allocation, such effects should have been minimal. It is difficult to avoid self-report measures when assessing dietary intake so the inclusion of the bagged chocolate measure in this study adds weight to the findings. Third, although differences between the cognitive defusion and control groups for the bagged chocolate reached a statistical significance, group differences for the diary measure showed a trend towards significance ($p = .053$) and thus should be treated with caution. Finally, although the handouts provided to the intervention and control groups were matched as far as possible, in order to accurately reflect the cognitive defusion and acceptance strategies, and the ways in which they tend to be used in practice, differences were inevitable. Indeed, one potentially important difference is that in the 5-min practice exercise, only participants in

the cognitive defusion group were asked to think about recent plans and thoughts in relation to chocolate (or to imagine future thoughts if no such plans came to mind), whereas participants in the control group were asked to think about a recent situation in which they had felt stressed (or to imagine future stressful events if no recent events came to mind). Participants in the acceptance group were asked to visualize their favourite type of chocolate in front of them. Thus, it is possible that being asked specifically to think about chocolate-related thoughts at baseline is what brought about the lower levels of chocolate consumption in the cognitive defusion group, rather than in the cognitive defusion strategy that was employed over the 5-day period. Arguably, thinking about chocolate-related thoughts is an important component of the cognitive defusion strategy because it is one way in which the individual may be encouraged to see themselves as different from their thoughts. However, it is possible that thinking about chocolate-related thoughts also prompted participants to engage in action planning in relation to their chocolate consumption. Given the evidence for the efficacy of action planning for behaviour change (e.g., Gollwitzer & Sheeran, 2006), this may in turn have been responsible for the reduced chocolate consumption. Because action planning can impact upon habits (e.g., Holland, Aarts, & Langendam, 2006), it might also account for the reduced automaticity amongst the cognitive defusion group in this study. It would be helpful to include an additional control in future studies to help rule out this possibility. It would also be informative to conduct additional studies that control for different aspects of the cognitive defusion strategy to help further pinpoint the exact elements that help bring about change, versus those elements that may be less important.

To conclude, our study demonstrates the impact of a mindfulness-based strategy (cognitive defusion) on a health-related behaviour that requires self-control over an extended period. The relatively simple nature of the strategy means it could be usefully incorporated into existing weight loss and healthy eating interventions. Further research should help establish whether it can also be applied to other self-control-related behaviours such as alcohol consumption, smoking cessation, and safe sex. Additionally, the results provide support for the hypothesis that cognitive defusion works by interrupting automatic links between chocolate consumption and thoughts that cue chocolate consumption. Finally, the research highlights the importance of distinguishing between different types of mindfulness strategies and separating out their effects on behaviour. Determining exactly which mindfulness strategies are helpful for which situations should help enhance both the efficacy and cost-efficiency of mindfulness-based intervention.

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References

Adriaanse, M. A., de Ridder, D. T. D., & Evers, C. (2011). Emotional eating: Eating when emotional or emotional about eating? *Psychology and Health*, *26*, 23–39. doi:10.1080/08870440903207627

Alberts, H. J. E. M., Mulkens, S., Smeets, M., & Thewissen, R. (2010). Coping with food cravings. Investigating the potential of a mindfulness-based intervention. *Appetite*, *55*, 160–163. doi:10.1016/j.appet.2010.05.044

Alberts, H. J. E. M., Schneider, F., & Martijn, C. (2012). Dealing efficiently with emotions: Acceptance-based coping with negative emotions requires fewer resources than suppression. *Cognition & Emotion*, *5*, 863–870. doi:10.1080/02699931.2011.625402

Alberts, H. J. E. M., Thewissen, R., & Raes, L. (2012). Dealing with problematic eating behaviour. The effects of a mindfulness-based intervention on eating behaviour, food cravings, dichotomous thinking and body image concern. *Appetite*, *58*, 847–851. doi:10.1016/j.appet.2012.01.009

Cleobury, L., & Tapper, K. (2013) *Reasons for eating 'unhealthy' snacks in overweight and obese males and females*. Manuscript submitted for publication.

Collis, J. M., & Elshaw, C. C. (1998). *The development of the trait self description inventory: Results of US/UK collaboration*. TTCP/HUM/98-001.

Davis, J. M., Fleming, M. F., Bonus, K. A., & Baker, T. B. (2007). A pilot study on mindfulness based stress reduction for smokers. *BMC Complementary and Alternative Medicine*, *7*, 2. doi:10.1186/1472-6882-7-2

Forman, E. M., Hoffman, K. L., McGrath, K. B., Herbert, J. D., Brandsma, L. L., & Lowe, M. R. (2007). A comparison of acceptance- and control-based strategies for coping with food cravings: An analog study. *Behaviour Research and Therapy*, *45*, 2372–2386. doi:10.1016/j.brat.2007.04.004

Gayner, B., Esplen, M. J., DeRoche, P., Wong, J. H., Bishop, S., Kavanagh, L., & Butler, K. (2012). A randomized controlled trial of mindfulness-based stress reduction to manage affective symptoms and improve quality of life in gay men living with HIV. *Journal of Behavioral Medicine*, *35*, 272–285. doi:10.1007/s10865-011-9350-8

Gifford, E., Kohlenberg, B., Hayes, S. C., Antonuccio, D., Piasecki, M., Rasmussen-Hall, M., & Palm, K. M. (2004). Acceptance-based treatment for smoking cessation. *Behavior Therapy*, *35*, 689–705.

Gollwitzer, P. M., & Sheeran, P. (2006). Implementation intentions and goal achievement: A meta-analysis of effects and processes. *Advances in Experimental Social Psychology*, *38*, 69–119. doi:10.1016/S0065-2601(06)38002-1

Hayes, S. C., & Smith, S. (2005). *Get out of your mind and into your life: The new acceptance and commitment therapy*. Oakland, CA: New Harbinger.

Hayes, S. C., Strosahl, K., & Wilson, K. (1999). *Acceptance and commitment therapy: An experiential approach to behavior change*. New York, NY: Guilford.

Hofmann, S. G., Sawyer, A. T., Witt, A. A., & Oh, D. (2010). The effect of mindfulness-based therapy on anxiety and depression: A meta-analytic review. *Journal of Consulting and Clinical Psychology*, *78*, 169–183. doi:10.1037/a0018555

Holland, R. W., Aarts, H., & Langendam, D. (2006). Breaking and creating habits on the working floor: A field-experiment on the power of implementation intentions. *Journal of Experimental Social Psychology*, *42*, 776–783. doi:10.1016/j.jesp.2005.11.006

Hölzel, B. K., Lazar, S. W., Gard, T., Schuman-Olivier, Z., Vago, D. R., & Ott, U. (2011). How does mindfulness meditation work? Proposing mechanisms of action from a conceptual and neural perspective. *Perspectives on Psychological Science*, *6*, 537–559. doi:10.1177/1745691611419671

Hooper, N., Sandoz, E., Ashton, J., Clarke, A., & McHugh, L. (2012). Comparing thought suppression and acceptance as coping techniques for food cravings. *Eating Behaviors*, *13*, 62–64. doi:10.1016/j.eatbeh.2011.10.002

Kabat-Zinn, J. (2003). Mindfulness-based interventions in context: Past, present, and future. *Clinical Psychology: Science and Practice*, *10*, 144–156. doi:10.1093/clipsy/bpg016

Kavanagh, D. J., Andrade, J., & May, J. (2005). Imaginary relish and exquisite torture: The Elaborated Intrusion theory of desire. *Psychological Review*, *112*, 446–467.

Kristeller, J. L., & Hallett, B. (1999). Effects of a meditation-based intervention in the treatment of binge eating. *Journal of Health Psychology*, *4*, 357–363.

Lawrence, N. S., Hinton, E. C., Parkinson, J. A., & Lawrence, A. D. (2012). Nucleus accumbens response to food cues predicts subsequent snack consumption in women and increased body mass index in those with reduced self-control. *NeuroImage*, *63*, 415–422. doi:10.1016/j.neuroimage.2012.06.070

Marlatt, G. A., Bowen, S., Chawla, N., & Witkiewitz, K. (2008). Mindfulness-based relapse prevention for substance abusers: Therapist training and therapeutic relationships. In S. Hick & T. Bien (Eds.), *Mindfulness and the therapeutic relationship* (pp. 107–121). New York, NY: Guilford.

Metcalfe, J., & Mischel, W. (1999). A hot/cool system analysis of delay of gratification: Dynamics of willpower. *Psychological Review*, *106*, 3–19. doi:10.1037/0033-295X.106.1.3

Moffitt, R., Brinkworth, G., Noakes, M., & Mohr, P. (2012). A comparison of cognitive restructuring and cognitive defusion as strategies for resisting a craved food. *Psychology and Health*, *27*, 74–90. doi:10.1080/08870446.2012.694436

Muraven, M., Baumeister, R., & Tice, D. M. (1999). Longitudinal improvement of self-regulation through practice: Building self-control strength through repeated exercise. *Journal of Social Psychology*, *139*, 446–457. doi:10.1080/00224549909598404

Muraven, M., Tice, D. M., & Baumeister, R. F. (1998). Self-control as a limited resource: Regulatory depletion patterns. *Journal of Personality and Social Psychology*, *74*, 774–789.

Neal, D. T., Wood, W., Labrecque, J. S., & Lally, P. (2012). How do habits guide behavior? Perceived and actual triggers of habits in daily life. *Journal of Experimental Social Psychology*, *48*, 492–498. doi:10.1016/j.jesp.2011.10.011

Neal, D. T., Wood, W., Wu, M., & Kurlander, D. (2011). The pull of the past: When do habits persist despite conflict with motives? *Personality and Social Psychology Bulletin*, *37*, 1428–1437. doi:10.1177/0146167211419863

Nederkoorn, C., Houben, K., Hofmann, W., Roefs, A., & Jansen, A. (2010). Control yourself or just eat what you like? Weight gain over a year is predicted by an interactive effect of response inhibition and implicit preference for snack foods. *Health Psychology*, *29*, 389–393. doi:10.1037/a0019921

Polivy, J., & Herman, C. P. (1985). Dieting and binging, a causal analysis. *American Psychologist*, *40*, 193–201.

Rozin, P., Levine, E., & Stoess, C. (1991). Chocolate craving and liking. *Appetite*, *17*, 199–212. doi:10.1016/0195-6663(91)90022-K

Tapper, K., Shaw, C., Ilsley, J., Hill, A., Bond, F., & Moore, L. (2009). Exploratory randomised controlled trial of a mindfulness-based weight loss intervention for women. *Appetite*, *52*, 396–404. doi:10.1016/j.appet.2008.11.012

Teasdale, J. D., Williams, J. M., Soulsby, J. M., Segal, Z. V., Ridgeway, V. A., & Lau, M. A. (2000). Prevention of relapse/recurrence in major depression by mindfulness-based cognitive therapy. *Journal of Consulting and Clinical Psychology*, *68*, 615–623. doi:10.1037//0022-006X.68.4.615

Tsukayama, E., Toomey, S. L., Faith, M. S., & Duckworth, A. L. (2010). Self-control as a protective factor against overweight status in the transition from childhood to adolescence. *Archives of Pediatrics & Adolescent Medicine*, *164*, 631–635. doi:10.1001/archpediatrics.2010.97

Van Strien, T. (2002). *Dutch Eating Behaviour Questionnaire (DEBQ)*. Manual. Bury St. Edmunds, UK: Thames Valley Test Company.

van't Riet, J., Sijtsema, S. J., Dagevos, H., & De Bruijn, G. J. (2011). The importance of habits in eating behaviour. An overview and recommendations for future research. *Appetite*, *57*, 585–596. doi:10.1016/j.appet.2011.07.010

Verhoeven, A. A. C., Adriaanse, M. A., Evers, C., & de Ridder, D. T. D. (2012). The power of habits: Unhealthy snacking behaviour is primarily predicted by habit strength. *British Journal of Health Psychology*, *17*, 758–770. doi:10.1111/j.2044-8287.2012.02070

Verplanken, B., & Orbell, S. (2003). Reflections on past behavior: A self-report index of habit strength. *Journal of Applied Social Psychology*, *33*, 1313–1330. doi:10.1111/j.1559-1816.2003.tb01951.x

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