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Citation: Jenkins, K. T. & Tapper, K. (2014). Resisting chocolate temptation using a brief mindfulness strategy. *British Journal of Health Psychology*, 19(3), pp. 509-522. doi: 10.1111/bjhp.12050

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Abstract

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 five 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 five-day period.

Results: Results showed that compared to controls, those in the cognitive defusion group ate significantly less chocolate from the bag ($p = 0.046$), and less chocolate according to the diary measure ($p = 0.053$). 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.

Keywords: mindfulness; acceptance; self-control; habits; diet; automaticity

Resisting chocolate temptation using a brief mindfulness strategy

Mindfulness is 'awareness that emerges through paying attention on purpose, in the present moment, and non-judgementally to the unfolding of experience moment by 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 et al., 2007; Gaynor et al., 2012; Gifford et al., 2004; Hofmann et al., 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 that 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 et al., 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 visualise 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 also 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 since most individuals report great liking for chocolate and it is also a food that elicits strong cravings (e.g., Rozin et al., 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 et al., 2010) whilst low levels are a factor associated with weight gain and higher BMIs (Lawrence et al., 2012; Nederkoorn et al., 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 sub-groups 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 et al., 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 et al., 2012). More recently, Moffitt et al. (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 seven-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 five, rather than seven-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., Adriannse et al., 2011; Cleobury & Tapper, under review; Neal et al., 2011; Verhoeven et al., 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, since 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). Since 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 among individuals who had been allocated to the cognitive defusion group.

Acceptance requires individuals to simply sit with, rather than 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 et al., 1998). Self-regulatory resources will also be needed to resist chocolate. Since self-regulation is believed to be a limited resource (Muraven et al., 1998), learning to accept rather than 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 hand-grip task (Muraven et al., 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 the first time since 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 since 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 summarise, 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 five-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 five-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 XXXX 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 versus 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 five 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 five days later at their follow-up appointment and the chocolates 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 five-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 three minutes, 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 twenty-five 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 five minutes 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 five 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 five-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 five 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 five 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 since 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 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, 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 minutes 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 five 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 can't 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 et al., 2008). In the practice exercise section participants were asked to visualise 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 minutes 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 minutes imagining this situation and practicing

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 practiced their technique for 5 minutes. The session took 20-25 minutes. 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. Since 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 five-day period (98% of participants in the control group, 93% in the cognitive defusion group, 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 hours. 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.

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 five-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 (13.22g). 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 (48.22g). 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 ($z = 1.998$, $p = 0.046$). The results also approached significance for chocolate recorded in the diary ($z = 1.933$, $p = 0.053$), 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, $z = 0.711$, $p = 0.477$; diary chocolate, $z = 0.027$, $p = 0.979$).

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) x 2 (time) ANOVA tests examined group differences in mediator score change. These showed no significant interaction for the handgrip task, $F(2, 132) = 2.13, p = 0.123$, but a trend towards a significant interaction for the SRHI, $F(2, 132) = 2.80, p = 0.064$. There was also a significant main effect of time on SRHI score, $F(1, 132) = 131.59, p = 0.001$ with means indicating an overall reduction in automaticity between baseline and follow-up ($M = 3.41, SD = 0.84$ and $M = 2.33, SD = 0.98$ 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 ($M = -0.78, SD = 1.02$), $t(88) = 2.33, p = 0.022$, but no difference between the acceptance group ($M = -1.16, SD = 1.13$) and the control group, $t(88) = 0.63, p = 0.53$. Across the whole sample, SRHI score at follow-up showed significant (Spearman's) correlations with both diary chocolate ($r = .21, p = <.05$) and chocolate from the bag, ($r = .20, p = <.05$) 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, ($M = 3.80, SD = 4.62; z = 1.683, p = 0.092$), or between participants in the acceptance group ($M = 3.58, SD = 3.32$) compared to

the control group, ($z = 0.428$, $p = 0.669$). 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, $M = 3.09$, $SD = 0.70$, compared to the control group, $M = 2.73$, $SD = 0.65$; $t(88) = 2.49$, $p = 0.015$. Differences between the defusion group, $M = 3.00$, $SD = 0.64$, and the control group approached significance; $t(88) = 1.96$, $p = 0.054$, but there were no significant differences between the acceptance and defusion groups, $t(88) = 0.628$, $p = 0.532$.

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 five-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-minute 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, since 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 et al., 2012; reducing cravings by loading the visuospatial sketchpad of working memory, Kavanagh et al., 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., Tapper et al., 2009; Gifford et al., 2004), 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 five-day period. Thus any increase in chocolate cravings experienced by this group did not appear to be associated with increased consumption. This is relevant since 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, since feelings are linked to the 'hot' stimuli the participant is trying to resist, this may actually make self-control more difficult (Metcalf & 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 break old ones (van't Riet et al., 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, since 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 statistical significance, group differences for the diary measure showed a trend towards significance ($p = 0.053$) 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 minute 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 visualise 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 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 since 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. Since action planning can impact upon habits (e.g., Holland et al., 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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Table 1.

Baseline characteristics across the defusion, acceptance and control groups.

Characteristic (scale)	Defusion (n = 45)	Acceptance (n = 45)	Control (n = 45)
^a Age (M, SD)	20.11 (2.29)	20.58 (2.08)	20.67 (2.76)
^c Sex (% females)	71.0	71.0	71.0
^b Current level of study (% undergraduates)	91.0	87.0	93.0
^b Liking for chocolate (1-7) (median and inter-quartile range)	7 (6.00-7.00)	7 (6.00-7.00)	7 (6.00-7.00)
^b Frequency of chocolate consumption (1-7) (median and inter-quartile range)	6 (5.00-7.00)	6 (4.50-6.00)	5 (4.00-6.50)
^c Desire to reduce chocolate consumption (1-5) (median and inter-quartile range)	4 (3.00-5.00)	4 (3.00-4.50)	4 (3.00-4.00)
^c Currently dieting (% yes)	13.0	20.0	9.0
^a Openness (OCEAN) (1-9) (M, SD)	45.38 (10.30)	42.02 (13.01)	41.07 (11.38)
^a DEBQ - Emotional (1-5) (M, SD)	3.14 (0.90)	2.95 (0.92)	2.69 (0.90)
^a DEBQ - External (1-5) (M, SD)	3.60 (0.62)	3.63 (0.72)	3.53 (0.76)
^a DEBQ - Restricted (1-5) (M, SD)	2.66 (0.87)	2.65 (0.93)	2.49 (0.83)

Note: Non-parametric tests were employed where K-S tests indicated

significantly non-normal distributions. A significant difference was evident

between the Defusion and Control groups ($p = 0.020$) for the DEBQ – Emotional

measure. There were no other significant differences.

^at-Test, ^bMann-Whitney U, ^cChi square

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 (grams)			Total grams of chocolate consumed ^a
	Mean (SD)	Minimum	Maximum	Mean (SD)	Minimum	Maximum	Mean (SD)
Defusion	0.02 (0.15)	0.00	1.00	13.22 (30.80)	0.00	136.25	13.43 (31.28)
Acceptance	0.27 (0.95)	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)

^aChocolates from the bag each weighed approximately 9.5 grams