The University of Birmingham

MSc Psychology

The Influence of Brief Mindfulness-Based Training on Food Cravings and Food Intake after Food Exposure

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ABSTRACT

Research has shown that mindfulness meditation may help in control over eating. This study aimed to examine the effects of four sessions of mindfulness-based training on food cravings and food intake. Forty-two healthy undergraduate females participated in a cue exposure paradigm. Following listening to an audio recording with mindfulness-based instructions, or to an audio book in a control group, participants were served a portion of cookies. Appetite and mood ratings were assessed using visual analogue scales before and after listening. Mindfulness training did not change food cravings, and did not decrease consumption as compared to a control group. In contrast, those in the control group reported a significantly higher level of hunger, while the level of hunger reminded stable in the mindfulness group. Brief mindfulness training does not appear to affect food cravings or food intake, but may prevent changes in hunger after cue exposure.

Acknowledgements

No problem can be solved from the same level of consciousness that created it.

Albert Einstein

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INTRODUCTION

We are continually bombarded by food stimuli and our brains are highly sensitive to its presence (Barrós-Loscertales et al., 2012; Papies, 2013; Volkow et al., 2002; Wang et al., 2004). The food environment has changed completely in the last century and our natural strategies to respond to it may be unsuccessful. Researchers agree that environment plays the most important role in the development of obesity and other chronic lifestyle diseases (Marteau, Hollands, & Fletcher, 2012; Osei-Assibey et al., 2012). Unsurprisingly, it can be difficult to change one's environment (Gortmaker et al., 2011) or avoid food exposure, and it can be challenging to maintain healthy eating habits when surrounded by highly palatable food. An important question is, can we respond to these temptations in a healthy, non-automatic manner?

Mindfulness originates from Buddhist philosophy. Substantially, mindfulness is a process which involves bringing an attitude of curiosity, openness and acceptance to the wandering mind and in which attention is maintained on immediate experience of the present moment (Bishop, 2004). One attempts to focus on breath, observe any thoughts, emotions and physical sensations and refrains from reacting with judgement, avoidance, or elaboration. When the mind wanders, one redirects the attention back to the breath (Bishop, 2004). Mindfulness was first applied as a clinical programme for chronic pain (Kabat-Zinn, 1982), which further became known as Mindfulness-Based Stress Reduction (Rosenzweig et al., 2010). It has also been incorporated into therapy for depression (Piet & Hougaard, 2011; Teasdale et al., 2000) and relapse prevention for substance abuse (Bowen et al., 2009). Mindfulness addresses cravings by developing a detached awareness of thoughts and sensations without reacting to them in a habitual manner (Kabat-Zinn, 2003).

Food cravings are problematic. They have been defined as an intense, irresistible desire for specific food (Gendall, Joyce, & Sullivan, 1997; Weingarten & Elston, 1990). Not only food exposure, but also externally-imposed restrictions elicit cravings (Kemps, Tiggemann, & Grigg, 2008; Stirling & Yeomans, 2004), which is consistent with Tiffany's model of drug use (Tiffany, 1999). Most people experience food cravings (Gendall et al., 1997), which may lead to consumption in individuals highly preoccupied with food (Forman et al., 2007; Forman, Hoffman, Juarascio, Butryn, & Herbert, 2013).

Several strategies have been developed to target food cravings. Suppressing them was found to be unsuccessful, because it results in overeating (Barnes & Tantleff-Dunn, 2010; Hooper, Sandoz, Ashton, Clarke, & McHugh, 2012; Stirling & Yeomans, 2004), and creates emotional imbalance (reviewed by Skinner & Aubin, 2010). In contrast, accepting cravings reduced them more effective than distraction or cognitive restructuring (Forman et al., 2007, 2013). Participants who received 30 minutes- (Forman et al., 2007) or 2 hours-training (Forman et al., 2013) in acceptance approach reported fewer cravings in real-life conditions than those who were told to distract themselves. Contrary to these results, cognitive defusion (experiencing thoughts from a distance) resulted in more cravings in real-life conditions than suppression, but participants who used this strategy ate less in the subsequent taste test (Hooper et al., 2012). Increases in cravings were also reported after participants received 5 minutes-instructions to accept cravings in laboratory conditions (Alberts, Thewissen, & Middelweerd, 2013). Alberts and colleagues argued that acceptance-based training increased awareness of cravings and that the attenuation of craving responses is a result of staying with the experience without reacting to it. Unfortunately, food intake was not measured in this study. Acceptance and cognitive defusion are only some of the components of mindfulness approach, and mindfulness was not the primary intervention in the above studies. Papies and Marchori (2014) also investigated the effect of only one aspect of mindfulness – a body scan

– on immediate food intake in laboratory conditions. They found that it did not affect how participants reacted to the external cue of portion size when compared to participants who listened to an audio book. However, evidence from long-term trainings have shown beneficial effects of mindfulness on food cravings, emotional and external eating (Alberts, Thewissen, & Raes, 2012; Daubenmier et al., 2011), and binge-type eating (Dalen et al., 2010; Kristeller & Hallett, 1999; Kristeller & Wolever, 2011). A recent review confirmed that strict mindfulness-based interventions may be effective in reducing binge eating behavior and emotional eating (Katterman, Kleinman, Hood, Nackers, & Corsica, 2014).

Strict brief mindfulness-based interventions have been also used in the treatment of addictive behaviors, where they target cravings (Zgierska et al., 2010). Drug cravings and food cravings activate common brain pathways (Tang, Fellows, Small, & Dagher, 2012; Volkow, Wang, Fowler, & Telang, 2008), and therefore these studies may serve as a good comparison here. For example, in a randomised clinical trial participants showed a greater reduction in cigarette use during the eight weeks of mindfulness training and follow up than participants treated traditionally (Brewer et al., 2012). Further, Bowen and Marlatt (2009) observed that one session of mindfulness instructions did not influence cravings for cigarettes, but resulted in a reduction in smoking in the subsequent week, as compared with a no-instruction control group. Another study found that the more individuals practised mindfulness the less they smoked, regardless of the level of their cigarette craving (Elwafi, Witkiewitz, Mallik, Thornhill, & Brewer, 2013). The time spent on meditation was also the best predictor of improvement in control over eating (Kristeller & Hallett, 1999). More recently, neurobiologists found that mindful attention to cigarette cravings decreased the subjective experience of craving and its neural correlates (Westbrook et al., 2013).

As described above, findings regarding mindfulness and food cravings have been mixed and, to date, there have been no studies in laboratory conditions examining the

relationship between strict mindfulness-based training, food cravings, and food intake. We therefore aimed to investigate the effects of brief training on cravings for specific foods and food intake. The training involved all components of mindfulness, and cravings were not explicitly targeted. Participants were guided to focus on breath and body, and instructed to observe their thoughts without judging them, and reacting to them. The exploratory hypothesis of this study was that participants in the mindfulness intervention would report more food cravings, but would eat less as compared to a control group.

METHOD

Participants

Forty-seven healthy female students from the University of Birmingham were recruited using the online research participation scheme, whereby Psychology students participate in an exchange for course credit. Participants with self-reported past or present history of eating disorders, allergy to chocolate chip cookies, and regular smoking (because of an overlap between cravings induced by smoking and food cues; Styn, Bovbjerg, Lipsky, & Erblich, 2013) were excluded. Only those who liked chocolate chip cookies were included. Only females were tested as there is evidence that males experience food cravings in a different way (Barnes & Tantleff-Dunn, 2010; Lafay et al., 2001; Wang et al., 2009). Given that experienced meditators present a better attentional performance (Chambers, Lo, & Allen, 2007; Jha, Krompinger, & Baime, 2007), and different brain activity (Hölzel et al., 2007; Taylor et al., 2013), the study was restricted to naive meditators. Three participants completed only the first session and two participants were excluded due to technical problems, resulting in a sample of 42 participants. The average age was 19.2 years (*SD* = 1.41, range: 18–27 years), and the average body mass index (BMI) was 21.8 kg/m^2 (*SD* =

3.07, range: 16.9–21.8). G-power analysis shown that with an effect size of 0.8 and an alpha level of 0.05, we needed to recruit 40 participants to obtain a power of 0.8.

Design

The study design was a two-group randomised experiment. Participants were randomly assigned to groups by alternate allocation. The study was approved by the University of Birmingham Research Ethics Committee.

Intervention

Mindfulness Group. The mindfulness instructions (Appendix A) were created based on a transcript from a study by Bowen and Marlatt (2009), and a transcript from the Insight Meditation Center in Redwood City, California. Before listening, participants read a brief introduction to the training (Appendix B) and were instructed to sit comfortably and close their eyes. They were given instructions to simply notice what was happening in the present moment, to focus on the body ("See if there are any places in your body where you can relax some of the muscles."), and on the breath. They were asked to pay attention to thoughts and sensations, and accept them ("The idea is to know what is happening without judging it."). Food cravings were mentioned as an example of thoughts ("You might notice thoughts about what has happened or what is coming next, or you might experience cravings for food."). They were also taught to see their thoughts from a distance.

Control Group. Participants were asked to close their eyes and relax during listening. They listened to an audio book of J.R.R. Tolkien's *The Hobbit*, which had also served as a control in previous studies (Johnson, Gur, David, & Currier, 2013; Zeidan, Johnson, Diamond, David, & Goolkasian, 2010). Any parts with food-related words were omitted. The beginning of the story was played during the first session, and the story was then continued during the following sessions.

Materials

Baseline Questionnaire (Appendix C). Participants provided demographic information, such as their age, gender, ethnicity, current diseases, past or present history of eating disorders, food allergies, and smoking status. This questionnaire also included questions about participants' sense of taste and smell (occurrence of taste/smell disorders, use of medication influencing smell/taste) to support the cover story. Participants also provided information about their dieting status and meditation experience.

Food Intake. Participants were served two types of chocolate chip cookies (Barton's Food and Merba) and a glass of water. Cookies were served in white bowls. Each portion weighed 150g, and participants were served 200ml of water. Food intake was assessed with a food scale and computed by subtracting intake from the amount served.

Appetite and Mood (Appendix D). Visual analogue scales (VAS) are validated measurements for appetite and mood rating (Gibbons, Caudwell, Finlayson, King, & Blundell, 2011; Parker et al., 2004; Stubbs et al., 2000). Current mood state, hunger, craving for cookies and thirst were rated on a 100mm horizontal line, from 0mm (*not at all*) to 100mm (*extremely*) before and after listening to the audio recording. Ratings were obtained by measuring the distance in millimeters from the left extremity of the lines. For mood state, six adjectives (happy, sad, stressed, relaxed, irritable, calm) were rated ("How…do you feel right now?"). For appetite ratings, questions about hunger, thirst and craving ("How much would you like to eat chocolate chip cookie right now?") were included.

Smell and Taste ratings. Participants gave smell and taste ratings for the two different types of cookies on VAS (Appendix E, F). They answered questions about smell and taste separately (these data were not analysed, and were only used to enhance cravings and support the cover story).

The Dutch Eating Behaviour Questionnaire (DEBQ). The English version of the DEBQ was used in order to measure three separate factors of eating behavior – dietary restraint, emotional eating, and external eating (Wardle, 1987). The scale has been shown to possess good reliability and measurement invariance (Barrada, van Strien, & Cebolla, submitted for publication). The restrained eating subscale (10 items) accesses intentions to restrict food intake due to concerns about weight. The emotional eating subscale (13 items) measures overeating triggered by negative emotions. The external eating subscale (10 items) contains items that refer to eating that are triggered by sight, smell, or the presence of others eating. The response format is a Likert-type scale, ranging from 1 (*never*) to 5 (*very often*). The scores were added up for every subscale. The questionnaire was displayed in Qualtrics software.

Manipulation Checks (Appendix G). To test whether participants improved their mindfulness skills, we used VAS to measure their ability to follow instructions, focus on breath, observe thoughts and feelings, accept them, and see them from a distance, after each mindfulness session ("How able are you to ….?"). This manipulation check was developed based on a previous design (Campbell-Sills, Barlow, Brown, & Hofmann, 2006).

Demand Awareness. Participants were asked to write the main question they thought the study was investigating, and to state if they had been aware of it before.

Procedure

We tested each participant individually on four consecutive days in a cubicle.

Session 1. Participants received an information sheet (Appendix I), and a consent form. We asked them to silence mobile phones and complete a baseline questionnaire, measuring demographics, individual characteristics and dieting history. Cookies and a glass of water were present on the table from the beginning of the experiment. Next, we instructed

participants to rate their appetite and mood. When the rating was completed, they received headphones and listened to the recording for 10 minutes. Recordings in both groups were matched for duration. After listening, participants in the mindfulness group rated their ability to follow the instructions, focus on breath, accept, observe, and see thoughts and emotions from a distance. Then all participants rated their appetite and mood.

Next, the smell and taste paradigm, which was based on a previous study (McVay, Copeland, Newman, & Geiselman, 2012), started. Participants rated smell and appearance of the first sample of cookies, but without eating them. Researcher left the room for 3 minutes. Then the same process was used for the second sample of cookies. In the next stage, participants rated various qualities of the taste. They were told that they could eat as much as they wanted, because the food would be thrown away. They were left in the room for 5 minutes. Then the same process was used for the second sample of cookies. Cookies were weighed before and after the session.

Sessions 2 and 3. All participants listened to the recording for 13 minutes (the time of mindfulness recording was extended by periods of silence to allow individuals to practice mindfulness). After listening, participants in the mindfulness group rated their mindfulness skills, while participants in the control group rated their mood (mood scores were not included in the analysis, and were only given to participants to support the cover story).

Session 4. Food exposure and food intake procedures were the same as on session one. Participants listened to an extended recording for 15 minutes. After the taste test, they were asked about their awareness of the aim of the study. Finally, all subjects completed data on the DEBQ scales, and their height and weight were measured using electronic digital scales and a stadiometer to calculate BMI.

Analysis

Independent-samples *t* test was used to explore whether there were any significant differences between baseline measures of age, BMI, DEBQ, hunger, craving, thirst or mood. To reduce the likelihood of a Type I error, six mood ratings (happiness, sadness, distress, irritability, relaxation and calmness) were grouped based on the bivariate Pearson's correlation. Happiness, relaxation and calmness were positively correlated and grouped as positive mood. Sadness, distress and irritability were grouped as negative mood.

A two (mindfulness, control) by two (session one, session four) repeated measures analysis of variance (ANOVA) was conducted to determine whether there was a significant effect of condition on food intake. Further, to determine whether mindfulness training had a significant effect on craving, a 2 x 2 x 2 ANOVA was conducted. Craving was analysed at two time points: pre-audio and post-audio. Similarly, a repeated measures ANOVA was used to compare the effects of condition on participants' hunger and mood. In addition, to analyse mindfulness skills in the mindfulness group a separate ANOVA was used. Pairwise deletion was used to treat missing data. Significance was accepted at $p < .05$ and all statistical analyses were completed using SPSS statistical software.

RESULTS

Participant Characteristics

The remaining 42 participants completed four sessions and were included in the analysis. There were 21 participants per group. Six participants were underweight, five subjects were overweight, and the rest were normal weight. Four participants were on a diet at the time of testing. All participants were non-smokers, naive to meditation, and have

shown likeliness for chocolate chip cookies. Seventy-six percent of the sample were White, 10% were Mixed Asian, 7% were Chinese, 2% were Black, and 5% were Asian-British.

Baseline Measures

Table 1. shows differences in age, BMI, eating behavior characteristics (DEBQ; Emotional, External, and Restraint), baseline hunger, craving, thirst, and mood ratings across two conditions. Independent-samples *t* test revealed no reliable differences on these measures between the two groups. However, participants in the mindfulness group reported significantly higher negative mood before session one, and before session four. The negative mood was included as a covariate; however the analysis of covariance did not revealed any significant difference, so these results were not reported below.

Table 1

Baseline Measures by Group

	Mindfulness		Control			
	M	*SD*	*M*	*SD*	*T*	*p*
Age (years)	19	0.80	19	1.85	-.65	.52
BMI (kg/m^2)	21.55	3.41	22.06	2.75	-.54	.59
DEBQ, Emotional (1 - 65)	33.43	6.22	33.38	9.90	.02	.99
DEBQ, External (1- 50)	32.52	4.50	34.38	5.07	-1.25	.21
DEBQ, Restraint (1- 50)	25.48	8.85	28.24	10.00	-.90	.38
Hunger pre - session 1 (1-100)	54.90	19.04	51.19	27.53	.51	.61
Hunger pre - session 4 (1-100)	52.75	23.60	46.86	23.20	.81	.43
Craving pre - session 1 (1-100)	63.48	19.61	66.90	22.70	-.52	.60
Craving pre - session 4 (1-100)	61.45	22.45	56.05	21.96	-1.63	.11
Thirst pre-session 1 (1-100)	54.14	19.69	64.14	20.11	.78	.44
Thirst pre-session 4 (1-100)	62.05	20.23	64.57	19.21	-.41	.69
Positive mood pre-session 1 (1-100)	57.21	17.20	57.62	16.72	-.08	.94
Positive mood pre - session 4 (1-100)	60.45	12.77	60.65	19.92	-.04	.97
Negative mood pre-audio session 1 (1-100)	33.68	17.12	22.30	12.97	2.43	.02*
Negative mood pre-audio session 4 (1-100)	30.49	12.55	18.29	11.74	3.26	.00*

Note. DEBQ: Dutch Eating Behaviour Questionnaire

* - indicates significant difference between mindfulness and control condition

Consumption of Cookies

A repeated-measures ANOVA with measurement session as a within subjects factor (two levels: session one, session four) and group as a between subjects factor was carried out to assess differences in food intake between groups. Contrary to what was expected, only a

significant main effect of a session emerged, F (1, 40) = .52, p =.03, ηp^2 = .11, but there was neither an effect of a group, F (1, 40) =.13, p = .91, ηp^2 = .00, nor an interaction, F (1, 40) = .20, p = .66, ηp^2 = .01. Both groups ate more cookies on session four, than on session one (see **Figure 1**). The mindfulness group ate approximately four grams of cookies more on session four than on session one, which equals 20 kilocalories. Control group ate approximately six grams of cookies more, which equals 30 kilocalories. From the practical point of view the consumption has changed only a little.

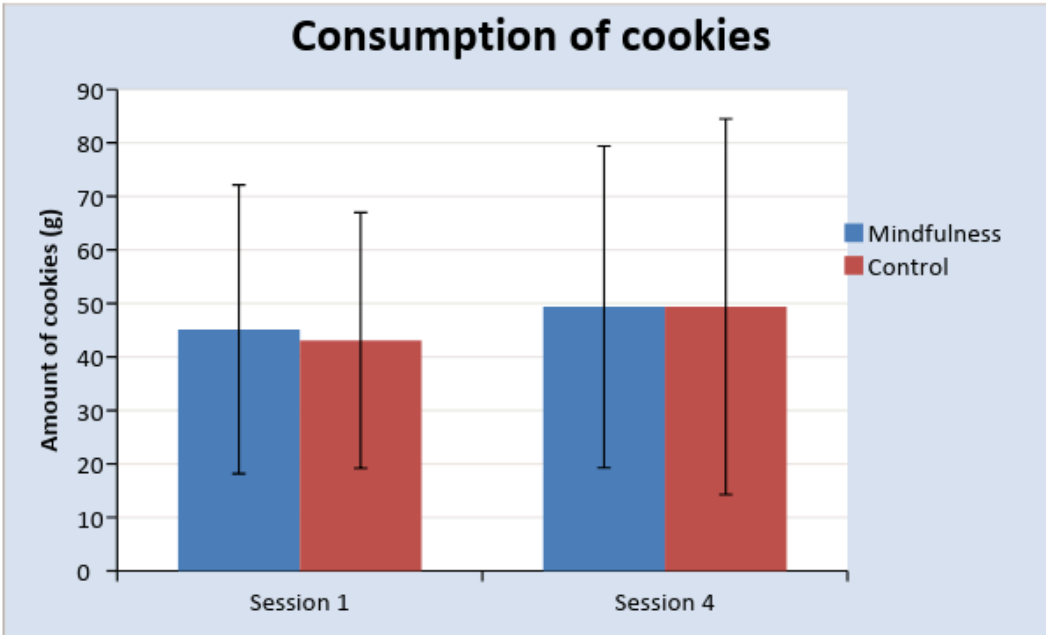

Figure 1.Consumption of cookies by experimental condition on both sessions. No food intake differences were found between groups. Standard deviations are represented in the figure by the error bars attached to each column.

Craving for Cookies

A repeated-measures 2 x 2 x 2 ANOVA with measurement session (two levels: session one, session four), and time as a within subjects factors (two levels: pre-audio; post-audio), and group as a between subjects factor was used to assess differences in food cravings between the conditions. It was hypothesised that the training would increase food

cravings. This analysis revealed a nearly significant effect of time on craving for cookies, F (1, 37) = 3.57, p = .07, ηp^2 = .09, whereby all participants reported higher cravings at post-audio measurement than on pre-audio measurement during both sessions. There was neither a session effect, F (1, 37) = 2.35, p = .13, ηp^2 = .06, nor a group effect, F (1, 37) = .08, p = .78, ηp^2 = .00. There was only a session by time interaction, F (1, 37) = 4.72, p = .04, ηp^2 = .12. Paired samples t tests revealed no significant differences from pre- to post-scores on the first session, t (39) = -.92, p = .37, but there was a significant increase from pre- to post-scores on the fourth session, t (39) = -3.38, p = .002. All participants reported significant increase in cravings from pre- to post-audio scores on the fourth session, but not on the first session (see Table 2).

Table 2

Comparison of craving before and after listening to recording between two sessions (for the whole sample)

	Craving pre - audio (1-100)		**Craving post - audio (1-100)**			
	M	*SD*	*M*	*SD*	*t*	*p*
Session 1	65,80	21,98	67,65	20,93	.92	.37
Session 4	58,15	22,10	63,48	21,68	-3.38	.002 *

Note. * - indicates significant difference between

Mood and Hunger

There was only a significant effect of time for positive mood, F (1, 37) = 66.34, p = .00, ηp^2 = .65, whereby all participants reported increase in positive mood from the pre-audio (M = 58.63, SD = 2.34) to post-audio scores (M = 73.53, SD = 1.88) during both, first and fourth session. Similarly, all participants reported decrease in negative mood from the pre-audio (M = 26. 19, SD = 1.79) to post-audio scores (M = 19. 25, SD = 1.62) during both sessions, F (1, 37) = 43.66, p = .00, ηp^2 = .52.

There was no time or group effect for hunger. Interestingly, there was a significant time by session interaction, F (1, 37) = 4.24, p = .05, ηp^2 = .11, and time by group interaction for hunger, F (1, 37) = 6.13, p = .02, ηp^2 = .15. For the mindfulness group, there were no significant differences in hunger between the pre- and post-scores during the first session, t (18) = -.57, p = .58 ($M_{pre\text{-}audio}$ = 56.32, SD = 19.50, $M_{post\text{-}audio}$ = 58.53, SD = 22.68), neither during the fourth session, t (18) = 1.35, p = .19 ($M_{\text{pre-audio}}$ = 51.68, SD = 23.76, $M_{\text{post-audio}}$ = 46.58, SD = 23.66). In contrast, participants in the control condition reported a significantly higher level of hunger at the post-audio scores on the first session, t (20) = -2.97, p = .008 ($M_{\text{pre-audio}}$ = 51.19, SD = 27.53, $M_{\text{post-audio}}$ = 64.33, SD = 25.74), and nearly significantly higher level of hunger at the post-audio scores on the fourth session, t (20) = -1.85, p = .07 ($M_{\text{pre-audio}}$ = 46.86, SD = 23.20, $M_{\text{post-audio}}$ = 52.33, SD = 25.34). Whereas the hunger of experimental group remained relatively stable over time, the control group showed a significant increase in hunger.

Manipulation Check

A repeated-measures ANOVA revealed no effect of session (four levels; session one, session two, session three, session four) on the ability to follow the instructions F (3, 20) = 1.83, p = .12, ηp^2 = .08, nor on the ability to focus on breath F (3, 20) = 1.09, p = .36, ηp^2 = .05. Again, there was no effect of session on the ability to accept thoughts and emotions F (3, 20) = 1.42, p = .25, ηp^2 = .07, nor on the ability to see thoughts and emotions from a distance F (3, 20) = .89, p = .45, ηp^2 = .04. In contrast, participants in the mindfulness group significantly increased their ability to observe thoughts and emotions through the training F (3, 20) = 3.97, p = .01, ηp^2 = .17 (see **Figure 2**). When only session one and session four were compared, there was also a nearly significant improvement in the ability to

follow the instructions, t (20) = -2.05, p = .053, and in the ability to accept thoughts and emotions, t (20) = -1.91, p = .07.

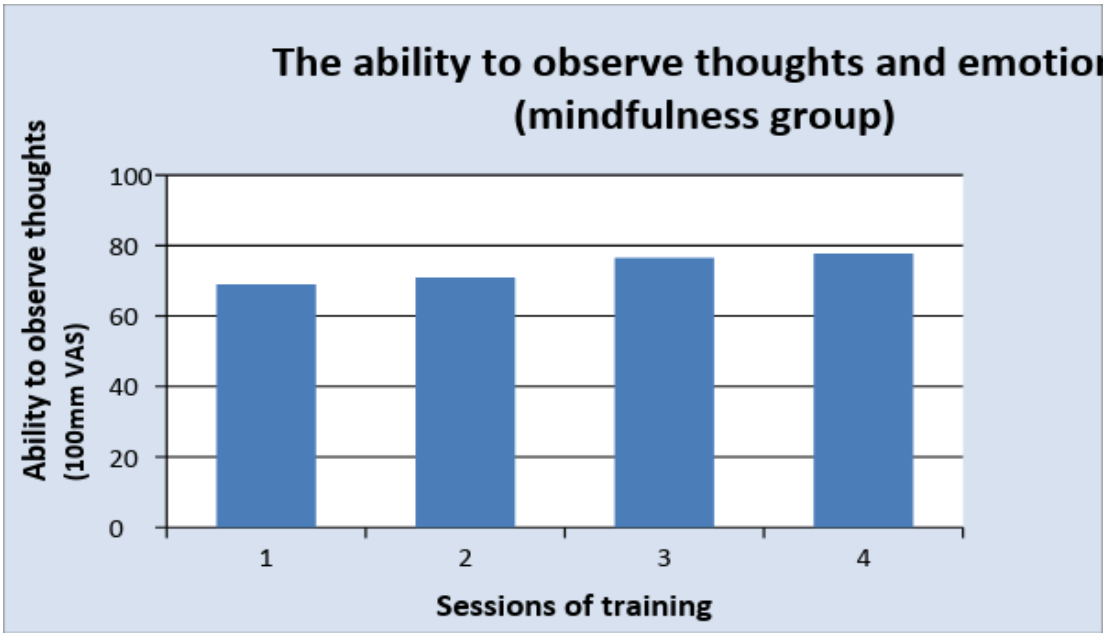

Figure 2. Changes in self-reported ability to observe thoughts and emotions during the mindfulness based training.

Demand Awareness

Most of participants did not guess the purpose of the study. Five participants thought the study examined the effect of relaxation on food intake, and one participant thought it tested the effect of meditation on food intake. None of them reported being aware of these objectives before answering the question.

Discussion

The results of this study did not confirm the hypothesis that four sessions of mindfulness-based training would increase cravings and decrease food intake. Participants in both groups reported more cravings on the last session, but not after the first session. Also, all

participants ate more on the last day of training, which could be due to their familiarity with the study, and their expectations for food.

The original hypothesis that cravings would increase after short training was based on the potential of mindfulness in increasing awareness of thoughts (Awasthi, 2012). Bowen and Marlatt (2009) also did not find changes in self-reported cigarette cravings between a group which applied a short set of strict mindfulness instructions and a group without instructions. In contrast, Alberts et al. (2013) reported that their acceptance group had more food cravings than their suppression or no-instruction groups. Further, Hooper et al. (2011) showed that their cognitive defusion group reported more cravings, but ate less food in a taste-test, than their suppression or no-instruction groups. However, in the above studies instructions were targeted explicitly towards cravings, while in our study participants were asked to notice and accept any thoughts and emotions that arose. In addition, immediate food intake was not measured in the above studies. On the other hand, Marchiori and Papies (2014) measured food intake after a short body-scan and found that it did not affect how participants reacted to the external cue of portion size, which is consistent with our findings, whereby brief training did not influence the amount of food eaten.

An additional finding from our study was that the level of hunger increased from pre- to post-training scores in the control group, while it remained relatively stable in the mindfulness group. The fact that the focus on breath and body sensations was emphasised in the training in comparison to other components may explain the effect found on hunger. Focusing on breath and body is also relatively easy to understand. Focus on breath and body could help participants to connect to internal cues, and become more aware of their physical sensations. It appears that the level of hunger was not influenced by the sight and smell of cookies in the mindfulness group. Following the two factor theory by Weingarten the meal initiation depends on two mechanisms: depletion-induced hunger, and incentive-induced

hunger (Weingarten, 1985). It could be possible that the level of hunger in the control group had changed due to the external stimuli, and that this is why participants reported stronger hunger. Perhaps, participants in the control group could have mistaken hunger (needing to eat because of an energy deficit) with craving for cookies (wanting to eat because of the rewarding properties of a food). All participants reported increase in cravings during the last session, but for the control participants this could have been indistinguishable. This is in line with the proposed Dual-Factor Model of Hunger (Lowe & Levine, 2005, p.801), Lowe and Levine distinguished "homeostatic hunger" from "hedonic hunger" based on a person's current energy status, "with need-based eating referring to intake motivated by an energy deprived state and want-based intake referring to intake driven primarily by external factors" (p.801). We did not ask participants to fast before the study, because we intended to measure food intake when participants were not hungry. Instead, we relied on participants' self-reported hunger. Unfortunately, we measured hunger in the presence of cookies, and we cannot therefore differentiate exactly between hedonic and psychological hunger. However, this order of measurement was the same for both groups, and therefore it does not undermine our findings. Mindfulness could have helped participants to connect to their internal cues, but it was not effective in helping participants to refrain from reacting to cravings. Given that participants were exposed to the sight and smell of cookies for the duration of a whole session, they may have been too preoccupied with this palatable food. For example, May et al. (2010) found that being aware of one's somatic sensations did not reduce the intensity of cravings in hungry participants. In addition, Papies and colleagues (2014) reported that body scans affected how participants reacted to internal hunger signals, but did not affect how they reacted to the external cue of portion size. The researchers found that participants who were hungrier ate significantly more, but only when in a controlled condition. Conversely, those who were in the body scan group did not eat more when their level of hunger was higher. Marchiori and Papies suggested that the body scan "made it easier for participants to refrain

from reacting to their feelings of hunger". In fact, reacting to "physiological hunger" would be an example of healthy behaviour; however, researchers in that study did not discriminate between hunger and cravings.

Lack of support for the hypothesis can be explained in several ways. First, the current study was probably too short to understand and fully develop the ability to see thoughts and accept them, separately from actions, and in turn avoid reacting to external food cues. Indeed, a recent study compared the influence of a two-week training period in different components of mindfulness on food cravings. Lacaille et al. (2014) found that only disidentification from thoughts was effective in reducing cravings, as opposed to a training which involved combined components of awareness and acceptance, or a mixture of awareness, acceptance and disidentification. In our study, participants in the mindfulness group increased their ability to observe thoughts and emotions, and to accept them, but not the ability to see them from a distance, or to focus on breath. Observing and being aware of thoughts is a pre-requisite for accepting them, or decentering from them, but Lacaille and colleagues argued that awareness on its own is insufficient to effectively manage cravings. Decentring, which is the process of viewing thoughts as events in the mind rather than as reflections of reality (Feldman, Greeson, & Senville, 2010), resulted in fewer intense cravings (Moffitt, Brinkworth, Noakes, & Mohr, 2012) and fewer binge eating episodes (Tapper et al., 2009). We put less emphasis on decentering in the training, and further studies should specifically emphasise this skill.

Not only could the length of the training have influenced the acquisition of mindfulness skills, but also the motivation and intention to learn could have had an effect. Following Bishop et al. (2004), researchers emphasised that intention is "crucial to understanding the process as a whole, and often overlooked in other contemporary definitions" (Shapiro, Carlson, Astin, & Freedman, 2006, p.376). In our study, all participants

were undergraduate Psychology students who took part in the study to get required credits. Perhaps participants did not have the intention to learn mindfulness, and also lacked the motivation to engage with the training. In contrast, in previous studies participants were strongly motivated to reduce cravings (Lacaille et al., 2014), were enrolled for obesity treatment (Alberts, Mulkens, Smeets, & Thewissen, 2010), were individuals with problematic eating behaviour (Alberts et al., 2012), or were attempting to lose weight (Tapper et al., 2009). Those participants seem to have had a personal intention to learn the skills. Finally, in long term interventions, participants were taught in groups by experienced teachers (Alberts et al., 2012; Dalen et al., 2010; Tapper et al., 2009), which improves motivation due to group support. Intention and motivation naturally occur in non-laboratory conditions, and to test the usefulness of mindfulness as a treatment for overeating, they should be taken into account.

Kabat-Zinn (2003) and Grossman (2011) recommended examining mindfulness in a personal context. However, the mindfulness practice should not involve the specified target, as for example reducing craving or food intake (Kabat-Zinn, 2003). The reason for this is that one feature of learning mindfulness is that one should not aim to achieve anything, but rather just attempt to focus on the present moment instead of thinking about results. Kabat-Zinn emphasised that if there is a strong willingness to achieve a specific target, it becomes easier to be caught up in habitual patterns of thinking. The current study did not ask participants to target cravings, and was advertised as a “relaxation and food preference” in order to reduce demand awareness. However, learning mindfulness involves the use of attentional control and is effortful in the early stages (Hasenkamp, Wilson-Mendenhall, Duncan, & Barsalou, 2012; Tang, Rothbart, & Posner, 2012). Therefore, the expectation of “relaxation” may have negatively influenced students’ ability to learn. Given that food cravings seem to impair attention and working memory (Kemps et al., 2008), and that cognitive performance of dieters or restrained eaters is impaired (Green, Rogers, Elliman, & Gatenby, 1994; Green &

Rogers, 1995; Higgs, 2007), it may be even more difficult to learn and directly apply new skills to manage food cravings. Furthermore, anxiety-sensitivity was associated with lower self-efficacy in managing cigarette cravings in the mindfulness condition (Rogojanski, Vettese, & Antony, 2011), and in addition, neurobiologists indicated that pre-existing profiles differentially predispose individuals to engage with meditation (Mascaro, Rilling, Negi, & Raison, 2013). Future research is needed to identify those who would benefit the most from mindfulness training.

The current study extends previous findings in at least two important ways. First, we investigated the short-term effects of mindfulness-based training, which enabled us to discriminate its effect on three different variables (cravings for specific foods, hunger, and food intake) which had not been measured together in any previous study. Second, we focused on a context in which individuals were not aware of the purpose of the study. Our study adds to the literature suggesting that compared with controls, mindfulness-based training helps to prevent an increase in hunger in the presence of palatable food. On the other hand, it does appear that four sessions of mindfulness-based training is too short a course to have any effect on food cravings and intake (though the sample may not have been sufficiently motivated to learn mindfulness). To our knowledge, no studies exist within the literature exploring the relative importance of interaction between motivation and intention to learn mindfulness, and duration of intervention.

Strengths and Weaknesses

The experimental work presented in this thesis has a number of strengths. This is the first study to provide data on whether four sessions of strict mindfulness-based training can influence food cravings and food intake. We explicitly avoided endorsing as goals the change of cravings and food intake, and the consistency between cover story and study design meant that the observed effects are unlikely to be explained by demand characteristics. Also, in

order to ensure that participants were listening to the recording, all sessions were conducted in the laboratory. We also did not manipulate the state of deprivation by imposing periods of deprivation or providing fixed meals or snacks in advance of the test meal in order to maintain the natural situation, whereby overeating and snacking occurs despite the satiety of the participants. Finally, instead of measuring dispositional mindfulness, which has been discouraged (Grossman, 2011; Park, Reilly-Spong, & Gross, 2013; Van Dam, Earleywine, & Borders, 2010) we developed visual analogue ratings to measure mindfulness skills. However, our approach requires further investigation as these concepts were explored in the current study using un-validated measures.

This study also had a few limitations. We recruited only healthy participants, who reported no history of eating disorders. It would have been useful to include a validated screening questionnaire for eating disorders, as it would have given us a more objective overview on the sample. Also, this cohort may have had fewer difficulties related to their eating habits than would be expected in a clinical sample. Thus, the capacity to detect an effect for the training may have been reduced. Additionally, only female undergraduate students were tested and therefore the results cannot be generalised. Finally, relied on self-reported measurement, and we did not measure mindfulness skills in the control group; it was found that measuring these skills in a control group results in non-meaningful increases, probably due to social desirability bias (Lacaille et al., 2014).

Recommendations

Future studies would benefit from recruiting participants who want to learn meditation, without asking them explicitly to apply mindfulness to manage their cravings. In addition, future studies could examine individual ability to learn mindfulness. Decentering from thoughts could be emphasised in future interventions with sufficient exercise delivered

in person. Finally, long-term training is needed to investigate how mindfulness influences hunger separately from cravings.

Conclusion

Not only individuals with problematic eating behaviour or high BMIs could benefit from mindfulness training. Those who do not present the above problems can improve their awareness of hunger after brief training. Potentially, after longer practice with a strong motivation to learn mindfulness, they can also manage food cravings, and prevent eating in response to food environment. Longitudinal studies of the health benefits of mindfulness in the prevention of unhealthy eating should be carried out.

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APPENDICES

Appendix A

Transcript for mindfulness instructions.

Get yourself in what feels like a stable and alert posture. Make sure your body is in a comfortable position. Gently close your eyes. This is a time for you to simply noticing, knowing what is happening in the present moment. Before you have any ideas about getting concentrated or being peaceful or making something happens – just noticing.

And as you pay attention to present moment, how easy is it to stay here and now? Are you operating on any ideas that something is supposed to happen? Trying to accomplish something, more than just notice?

Take a few long slow deep breaths. Breathing in deeply, and then as you exhale, relax in your body. Letting go whatever tension you can easily let go.

Now allow your breathing to return to normal. You don't have to breathe in any special way. Allow the breath to settle and to find its own natural rhythm. You can find it helpful to softly label in your mind the in-breath "in", the out-breath "out". Just a very quiet whisper in the mind that just encourages you to hang in there, stay present, instead of getting distracted.

Notice how the body moves in response to the breath: the chest expanding and relaxing, the belly rising and falling. See if there are any places in your body where you can relax some of the muscles. It might be possible to soften your forehead, your jaw. Then within your body, as part of your bodily experience, become aware of how your body experiences breathing. What happens in your body as you breathe? What moves, what changes, what shifts?

There might be a variety of things that might make it difficult for you to stay continuous with the breathing. Be relaxed about that and pay attention. The idea is to know what is happening without judging it. Know “I’m easily distracted. I’m easily concerned about other things.” Just know that. You might notice thoughts about what has happened or what is coming next or you might experience cravings for food. Sometimes it is possible to change these thoughts, or push them away, and sometimes that isn’t possible. Sometimes trying to get rid of a thought or emotion actually makes it stronger. Remember that having thoughts doesn’t mean you have to act on them; they are only thoughts, only words or sensations that pass through. You don’t have to allow thoughts to control your actions.

If thoughts arise, try to just accept them without any judgment of their being good or bad; right or wrong. If your mind wanders, just gently bring it back to what you are experiencing right now. Stay with the thoughts you are having, and any emotions or physical sensations as they arise and grow in intensity. Pay attention to them. Allow any discomfort to be present, noticing it and accepting it without judgment.

And just as it’s useful to take a few minutes to settle into meditation, it’s useful to take a little bit of time to come out of it. A simple way to do this is to take a few deep breaths again. Feel your body as you breathe in deeply.

Then when you’re ready you can open your eyes.

Appendix B

Instruction before listening to mindfulness recording.

I would like you to try a particular kind of awareness. The main aspects of this approach are: **paying attention to** the mind and body in a **present moment** with **openness** and **curiosity instead of judgement**.

Accepting thoughts and emotions as they are is also an important part of this method.

This audio will last for 10 minutes. After listening, please **try to use this approach during the whole session.**

Appendix C

Baseline questionnaire

1) **How old are you ? _____** (years)

2) **Please state your gender** (Please circle)
Male Female

3) **What is your ethnic group?** (Please circle)
- White
- Mixed Asian/ Asian British
- Black/Black British
- Chinese
- Other ethnic group

4) **Do you smoke regularly?** (Please circle)
Yes No

5) **Do you have any food allergies or strong food intolerances?** (Please describe)
_____

6) **Have you ever been on a diet (e.g. vegetarian, gluten free, elimination, weight-loss diet)?**
If yes, please describe the diet
_____

7) **Are you currently dieting to lose weight?**
Yes No
If yes, please describe the diet
_____

8) **Do you suffer, or have you ever suffered from any chronic illness (e.g. diabetes, depression)?**
Yes No
If yes, please describe the diagnosis
_____

9) **Do you suffer, or have you ever suffered from eating disorder?**
Yes No
If yes, please describe the diagnosis and time of illness
_____

10) **Are you taking any medication?**
Yes No
If yes, please state which
_____

11) **Do you meditate regularly?** ("Meditation can be defined as a practice that focuses on training attention and awareness with the goal of producing emotional calm, mental clarity, self-awareness, and/or concentration")
a) I meditate once a day
b) I meditate once a week
c) I meditate once a month
d) I do not meditate regularly
e) other:……

13) Do you like chocolate chip cookies?

a) Yes
b) No
c) I have never tried it

Appendix D

Appetite and Mood VAS

Put a vertical line across a horizontal line according to your degree of feeling.

How **happy** do you feel right now?

NOT AT ALL happy ——— EXTREMELY happy

How **sad** do you feel right now?

NOT AT ALL sad ——— EXTREMELY sad

How **stressed** do you feel right now?

NOT AT ALL stressed ——— EXTREMELY stressed

How **relaxed** do you feel right now?

NOT AT ALL relaxed ——— EXTREMELY relaxed

How **irritable** do you feel right now?

NOT AT ALL irritable ——— EXTREMELY irritable

How **calm** do you feel right now?

NOT AT ALL calm ——— EXTREMELY calm

How **hungry** are you right now?

NOT AT ALL hungry ——— EXTREMELY hungry

How much would you like to eat **chocolate chip cookie** right now?

NOT AT ALL strong ——— EXTREMELY strong

How **thirsty** are you right now?

NOT AT ALL thirsty | EXTREMELY thirsty

Appendix E

Smell VAS

Put a vertical line across a horizontal line according to your degree of feeling.

How would you rate the **smell intensity** of this food?

Extremely low or Absent _____ Extremely High

How **pleasant** do you find the smell of this food?

Not at all _____ Extremely

How do you like the **appearance** of this food?

Not at all _____ Extremely

How much would you like to **eat** this cookie now?

Not at all _____ Extremely

Appendix F

Taste VAS

Put a vertical line across a horizontal line according to your degree of feeling.

How would you rate the **flavour intensity** of this food?

Extremely low or Absent _____ Extremely High

How would you rate the **sweetness** of this food?

Extremely low or Absent _____ Extremely High

How **pleasant** do you find the taste of this food?

Not at all _____ Extremely

How do you like the **texture** of this food?

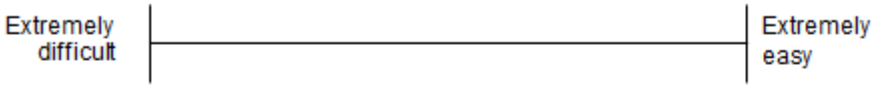
Not at all _____ Extremely

Appendix G

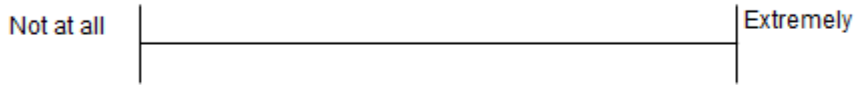
Manipulation Checks VAS

Put a vertical line across a horizontal line according to your degree of feeling.

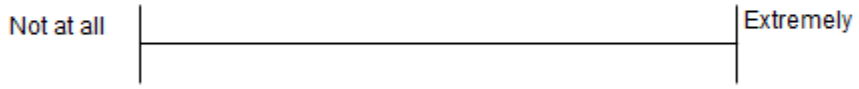
How easy was it for you to **follow** the audio instructions?



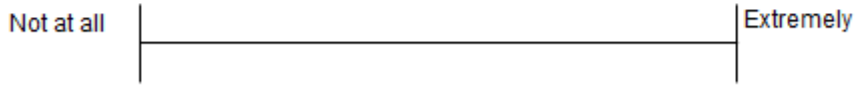
How able are you to **focus on your breath** now?



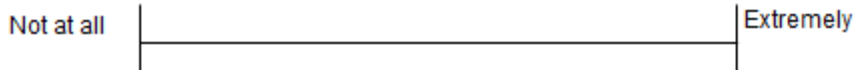
How able are you to **observe** your **thoughts and feelings** now?



How able are you to **accept** your **thoughts and feelings** now?



How able are you to **see your thoughts and emotions from a distance** now?



Appendix I

Information Sheet

RELAXATION AND FOOD PREFERENCE

Dear Volunteer,

We would like to invite you to take part in a research study. Take time to decide whether or not you wish to take part.

❖ Purpose of the study

This study aims to find out about how different aspects of relaxation influence food preference.

❖ Eligibility Requirements

- Non-smokers
- No allergy or strong intolerance to chocolate chip cookies
- No diagnosed eating disorders

❖ Do I have to take part?

Your participation in this research study is voluntary and you do not have to take part if you do not wish to. You are free to withdraw from the study at any time.

❖ The procedure

If you agree to participate, you will get **few questionnaires** about your lifestyle and eating habits **to fill on-line before you come for testing.**

We will ask you to come to the School of Psychology for **4 sessions within one week**. For the 1st and the 4th session you will have to spend 40 min and for the 2nd and 3rd only 20 min.

1) You will be asked to rate your food preferences of chocolate chip cookies, 2) **You will receive relaxation training during each session**, 3) You will be asked about your mood.

❖ Possible disadvantages and risks

If you are not allergic to above food, you will encounter no greater risks of discomfort than those incurred in routine daily activities.

❖ Possible benefits

You will have the opportunity to learn relaxation technique, which you can later use in your daily life if you only have the intention to do so. You will also get free food.

❖ Expenses and payments

If you take part in all sessions you will get 3 credits (after completing all sessions).

❖ Confidence of data

The data collected in this study will be used only for the purpose described in this form. Your identity will not be recorded as part of your data.

❖ Who is organising the research?

The research is organised by the School of Psychology, University of Birmingham. The results will form the basis of a final year project for a MSc in Psychology.

Supervisor: **Dr Suzanne Higgs** If you have any questions, please contact me by e-mail: **Aleksandra Klos: aak346@bham.ac.uk**