Appetite 71 (2013) 144–149

Contents lists available at ScienceDirect

Appetite

journal homepage: www.elsevier.com/locate/appet

Research report

A brisk walk, compared with being sedentary, reduces attentional bias and chocolate cravings among regular chocolate eaters with different body mass ☆

Hwajung Oh, Adrian H. Taylor *

College of Life & Environmental Sciences, University of Exeter, St Luke's campus, Heavitree Rd., Exeter, Devon EX1 2LU, UK

ARTICLE INFO

Article history:
Received 16 April 2013
Received in revised form 24 July 2013
Accepted 29 July 2013
Available online 17 August 2013

Keywords:
Exercise
Physical activity
Snacking
Food craving
Self-regulation
Inhibition

ABSTRACT

Poor self-regulation of high energy snacking has been linked to weight gain. Physical activity can acutely reduce chocolate consumption and cravings but the effects on attentional bias (AB) are unknown. The study aimed to test the effects of exercise among normal and overweight/obese individuals during temporary and longer abstinence. Participants were 20 normal and 21 overweight regular female chocolate eaters (after 24 h abstinence), and 17 females (after ⩾1 week abstinence during Lent). They were randomly assigned to engage in 15 min brisk walking or rest, on separate days. AB was assessed using an adapted dot probe task pre and post-treatment at each session, with chocolate/neutral paired images presented for 200 ms (initial AB; IAB) or 1000 ms (maintained AB; MAB). Chocolate craving was assessed pre, during, immediately after, and 5 min and 10 min after treatment, using a 0–100 visual analogue score. Three-way mixed ANOVAs revealed that there was no significant interaction effect between group (i.e., BMI status, or abstinence status) and condition × time for craving and AB to chocolate cues. Fully repeated 2-way ANOVAS revealed a significant condition × time interaction for IAB ($F(1,57) = 6.39$) and chocolate craving ($F(2.34,133.19) = 14.44$). After exercise IAB ($t(57) = 2.78$, $p < 0.01$) was significantly lower than after the rest condition. Craving was significantly lower than the rest condition at all assessments post-baseline. A short bout of physical activity reduces cravings and AB to chocolate cues, relative to control, irrespective of BMI or abstinence period.

Introduction

Subtle accumulative weight gain over time can result from poor self-regulation of daily snacking on high energy food sources, such as chocolate (Berteus Forslund, Torgerson, Sjostrom, & Lindroos, 2005; Bes-Rastrollo et al., 2010). Chocolate is a commonly craved food (Bruinsma & Taren, 1999; Rodríguez et al., 2007; Rozin, Levine, & Stoess, 1991), particularly among women, since it is highly palatable and associated with positive affect (Hetherington, 2001; Weingarten & Elston, 1990), and may share some features of addiction (Avena, Rada, & Hoebel, 2008; Hetherington & MacDiarmid, 1993).

Recent interest has extended from simple self-reported measures of craving to cognitive mechanisms (e.g., attentional bias (AB); Tapper, Pothos, & Lawrence, 2010). The Incentive-Sensitization Theory (Robinson & Berridge, 1993) and Elaborated Intrusion (EI) Theory (Kavanagh, Andrade, & May, 2005) underpin the idea that cravings and attentional bias can contribute to behaviour (Field, Maunafo, & Franken, 2009). Substance-related conditioned stimuli acquire the ability to grab attention and elicit cravings prior to substance-seeking behaviour (Field & Cox, 2008; Mogg, Bradley, Field, & De Houwer, 2003; Mogg, Field, & Bradley, 2005). Indeed, AB has been associated with self-reported craving (Field et al., 2009; Werthmann, Roefs, Nederkoorn, & Jansen, 2013), the level of substance dependence, and repeated unsuccessful quit attempts (Bradley, Mogg, Wright, & Field, 2003). Two different attentional processes appear to occur: Initial attentional bias (IAB) indicates a rapid automatic shift in attention when stimuli appear (e.g., 100–500 ms) and maintained attentional bias (MAB) is the subsequent AB to cues with longer exposure (e.g., 500–1000 ms) (Brignell, Griffiths, Bradley, & Mogg, 2009; Field & Cox, 2008; Mogg et al., 2005). The former is thought to indicate approach tendencies to a substance, but there is less clarity on the meaning of the latter. Substance users may consciously seek to avoid visual contact with substance images (i.e., avoidance) but others may be continually drawn to the cue, thus reflecting enhanced maintained AB. There is, nevertheless, a need for further research on AB and food cues,

☆ *Acknowledgements:* The research was conducted with the support of internal institutional funds. *Conflict of interest:* The authors have received no other direct or indirect support, and have no other connection with industry. The authors have no conflict of interest.

* Corresponding author.
E-mail address: a.h.taylor@exeter.ac.uk (A.H. Taylor).

0195-6663/$ - see front matter Crown Copyright © 2013 Published by Elsevier Ltd. All rights reserved.
http://dx.doi.org/10.1016/j.appet.2013.07.015

using a range of methods (e.g., eye tracking technology, modified dot probe task, event-related potential), and with specific food which may have strong attention capturing properties.

Several factors may influence craving and AB to food cues, such as individual differences and duration of deprivation from the specific food (Brignell et al., 2009; Nijs & Franken, 2012). Different responses between low and high body mass index groups on food cues have been reported in the literature (Nijs, Muris, Euser, & Franken, 2010). In a review paper, Volkow, Wang, and Baler (2011) reported that obese, compared with normal weight people, showed increased activation of reward-related brain regions (e.g., NAc, ACC, amygdala, hippocampus) when they were exposed to high-calorie foods. Ferriday and Brunstrom (2011) found that after cue exposure an overweight group showed greater response and greater motivation to consume food than a normal weight group. In an AB study, overweight females tended to have greater IAB to food in the hunger condition and gazed longer at food in the fed condition compared with normal weight females (Castellanos, Charboneau, Dietrich, et al., 2009): But this and other studies (e.g., Nijs et al., 2010; Werthmann et al., 2011) have not focused on AB among people with specific food interests. In a study involving habitual chocolate cravers, cue elicited cravers had greater AB to chocolate cues (Kemps & Tiggemann, 2009), with greater difficulty in disengaging from images (i.e., MAB).

In chocolate studies, to elicit craving, participants have been asked to abstained from eating chocolate for 1–2 days (Tapper et al., 2010), and it may be that an even longer-term abstinence (e.g., a week) elicits greater cravings. There is no biochemical verification test to confirm chocolate abstinence (unlike checks for smoking and alcohol abstinence) but many people do self-report abstaining during Lent and may be a useful population to examine chocolate cravings and AB. Also, involving naturally abstaining participants may provide greater generalizability than studies involving experimentally manipulating abstinence.

An increase in global obesity has been attributed to an increase in energy intake rather than a decline in total energy expenditure (Westerterp & Speakman, 2008), though there has been an increase in sedentary behaviour. Indeed sedentary time has been inversely associated with cardiometabolic (Henson et al., 2013) and mental health (Teychenne, Ball, & Salmon, 2010), and also with poor self-regulation of snacking, independent of hunger and appetite (Taylor & Ussher, 2013). If humans associate physical movement with reward and pleasure then sedentary time may lead to alternative conditioned reward seeking behaviours from food and other hedonic behaviours.

The enhancing effect of exercise on self-regulation of substance use (i.e., smoking and alcohol) has received considerable recent interest (Taylor, 2013; Haasova et al., 2013; Ussher, Sampuran, Doshi, West, & Drummond, 2004). Although the acute and chronic effects of exercise on hunger and appetite have been reported (e.g., Hopkins, King, & Blundell, 2010), few studies have examined the effect of exercise on food craving and snacking, among regular snackers. These few studies have reported that exercise reduces chocolate consumption in a work-simulation situation (Oh & Taylor, 2012), chocolate craving (Taylor & Oliver, 2009), visual attentional bias (using eye tracking technology) to snack food video clips (versus matched clips with neutral images) among abstinent smokers who reported frequent snacking (Oh & Taylor, 2013) and urge to snack (Thayer, Peters, Takahashi, & Birkhead-Flight, 1993). In the study by Oh and Taylor (2012) there was a trend for the greatest ad libitum consumption to occur after a 'low demand' (rather than 'high demand') mental task and rest (rather than exercise), which may suggest that boredom or deactivation may allow on-going thoughts about chocolate (even with none present). Thus increased cravings and attentional bias to such cues may eventually lead to a failure in self-regulation. All the above studies involved normal weight samples and only a few days of self-reported abstinence (except Thayer's study which involved no manipulated abstinence). If chocolate cravings and AB are greater among overweight and obese, and among those with longer abstinence, there may be greater scope to observe if a short bout of physical activity can have an effect on these chocolate outcomes.

Thus, the main aim was to assess whether a 15-min brisk walk, compared with a passive rest condition, decreased both IAB and MAB to chocolate images, using the dot probe task, and self-reported craving for chocolate. Secondary aims were to examine if any effects of exercise were moderated by weight, duration of abstinence, the tendency to be an emotional eater, and trait chocolate cravings.

We therefore hypothesised that brisk walking will cause a decrease in AB and subjective cravings for chocolate among abstinent regular chocolate eaters, compared with a passive control condition who have time to think about chocolate. It was expected that the effects may be more evident among those who are overweight/obese or have a strong craving after a longer period of abstinence.

Methods

Participants

Following approval by the Institutional Ethics Committee, participants were recruited through public messages (posted on walls and through email communication) or were given a flyer on the street and were screened by telephone. Previous research had revealed that overweight/obese individuals did not tend to respond to simple adverts, so we explicitly worded adverts to request those who had weight concerns. Similarly, specific adverts were circulated to target those abstaining from chocolate consumption during Lent. All participants who were 18–45 years of age were eligible for the study if they ate at least 100 g of chocolate (i.e., 2 chocolate bars) per day and responded in favour of having an interest in chocolate, using the following questions: "How would you describe the experience of eating chocolate?"; "I often have cravings for sweets", and "I often have craving for chocolate" using a 6-point Likert scale (1 = *very unpleasant or strongly disagree*, 6 = *very pleasant or strongly agree*). The value for each item was added and participants were eligible if their total score was greater than 12 out of a possible 18. An upper age limit of 45 years was used to comply with laboratory testing procedures to minimise risk when working with obese participants.

A previous pilot study (Taylor, Oliver, & Janse van Rensburg, 2009) informed our sample size calculations. They reported an effect size of 0.88 for the difference in AB to snack food following a 15 min moderate intensity cycle v. 15 min rest. We estimated that for a within-subject design, with a power of 0.95, and alpha of 0.05, a sample size of at least 19 per group would be needed to detect differences in AB to snacking images, involving a within-subjects design.

Procedures

Eligible participants were initially asked to record a 3-day chocolate diary then abstain from snacking on the 4th day guided by previous research (Tiggemann, Kemps, & Parnell, 2010). Participants who were planning to or were actually abstaining from chocolate during Lent were required to be abstinent for at least 1 week. After eating a normal meal (breakfast or lunch), they were asked not to eat, drink (except water) or exercise for 2 h prior to coming to the lab for each session. Upon arrival on Day 1, participants provided written informed consent. Height, weight, and physical activity (using the 7-day recall of Physical Activity questionnaire;