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Sustained effects of attentional re-training on chocolate consumption

Eva Kemps*, Marika Tiggemann, Joanna Elford

School of Psychology, Flinders University, Adelaide, Australia

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A B S T R A C T

Background and objectives: Accumulating evidence shows that cognitive bias modification produces immediate changes in attentional bias for, and consumption of, rewarding substances including food. This study examined the longevity of these attentional bias modification effects.
Methods: A modified dot probe paradigm was used to determine whether alterations in biased attentional processing of food cues, and subsequent effects on consumption, were maintained at 24-h and one-week follow-up. One hundred and forty-nine undergraduate women were trained to direct their attention toward ('attend') or away from ('avoid') food cues (i.e., pictures of chocolate). Within each group, half received a single training session, the other half completed 5 weekly training sessions.
Results: Attentional bias for chocolate cues increased in the 'attend' group, and decreased in the 'avoid' group immediately post training. Participants in the 'avoid' group also ate disproportionately less of a chocolate food product in a so-called taste test than did those in the 'attend' group. Importantly, the observed re-training effects were maintained 24 h later and also one week later, but only following multiple training sessions.
Limitations: There are a number of limitations that could be addressed in future research: (a) the inclusion of a no-training control group, (b) the inclusion of a suspicion probe to detect awareness of the purpose of the taste test, and (c) the use of different tasks to assess and re-train attentional bias.
Conclusions: The results showed sustained effects of attentional re-training on attentional bias and consumption. They further demonstrate the importance of administering multiple re-training sessions in attentional bias modification protocols.

1. Introduction

Contemporary Western environments are saturated with palatable food cues. People are continually exposed to images that are associated with food intake, such as advertisements on billboards and television, vending machines and fast food outlets. The mere presence of such food cues has been linked to increased food intake (Fedoroff, Polivy & Herman, 1997, 2003; Painter, Wansink & Hieggelke, 2002) and is an acknowledged contributor to the increased prevalence of overeating and obesity (Westerterp & Speakman, 2008).

One explanation for the link between food cue exposure and (over)consumption is that food cues "grab" attention. According to Berridge's (2009) Model of Food Reward, eating is a rewarding experience. Because of a continual association between food cues and the rewarding experience of eating, these cues become reinforcing. This classically conditioned association makes environmental food cues salient and attractive. As a result, they automatically capture (i.e., bias) attention, which then guides behaviour toward food acquisition and consumption.

Empirical evidence supports the link between food cue exposure and biased attentional processing. A number of studies have shown that pre-exposing participants to a selection of chocolate bars induces an attentional bias for chocolate cues (Kemps & Tiggemann, 2009; Smeets, Roefs, & Jansen, 2009). There are also several strands of correlational evidence in support of the link between attentional bias for food cues and (over)consumption. A growing number of studies have reported an enhanced attentional bias for food cues in overweight and obese individuals (Braet & Crombez, 2003; Kemps, Tiggemann & Hollitt, 2014; Long, Hinton, & Gillespie, 1994). Biased attentional processing of food cues has also been associated with an increase in body mass index one year later (Calitri, Pothos, Tapper, Brunstrom & Rogers, 2010; Yokum, Ng, & Stice, 2011). More direct evidence would come from research that

* Corresponding author. School of Psychology, Flinders University, GPO Box 2100, Adelaide, SA 5001, Australia.
E-mail address: Eva.Kemps@flinders.edu.au (E. Kemps).

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links attentional bias for food cues to actual consumption. In the only study to date, Nijs, Muris, Euser, and Franken (2010) reported a positive correlation between attentional bias and intake of high-caloric snacks.

In addition to these correlational studies, more recent experimental evidence is consistent with a causal role for attentional bias in food intake. In particular, attentional re-training studies have shown that an experimental manipulation of attentional bias can produce a commensurate change in consumption. For example, using a modified dot probe task, Kemps, Tiggemann, Orr, and Grear (2014) showed that participants who were trained to direct their attention *away* from chocolate pictures subsequently ate less of a chocolate food product than participants who were trained to direct their attention *toward* such pictures. Similarly, Werthmann, Field, Roefs, Nederkoorn, and Jansen (2014) found that participants ate more chocolate when they had to attend to chocolate pictures in an anti-saccade task and ate less chocolate when they had to attend to non-chocolate pictures, but only if they displayed high accuracy rates on the task. In contrast, Hardman, Rogers, Etchells, Houstoun, and Munafo (2013) failed to find any effect of attentional re-training of cake images on food intake.

Thus far, only immediate effects of attentional re-training effects on food intake have been investigated. However, if attentional bias modification is to have any practical application, it is important that its effects are maintained over time. Two recent attentional bias modification studies on alcohol have shown sustained effects of attentional re-training following multiple training sessions. In particular, Fadardi and Cox (2009) demonstrated sustained reductions in both attentional bias for alcohol cues and alcohol consumption in harmful drinkers three months after completing four weekly attentional re-training sessions. Likewise, Schoenmakers et al. (2010) administered five training sessions to alcohol-dependent patients and reported an increase in their ability to disengage from alcohol cues up to three to four days post-training. These patients also showed a delay in relapse times at three-month follow-up compared to a control group. In contrast, a study conducted in tobacco smokers found that while attentional bias modification altered attentional bias for smoking cues immediately after training following a standard single training session, this effect was no longer present 24 h later (Field, Duka, Tyler, & Schoenmakers, 2009). Collectively, these findings suggest that multiple training sessions may be required to produce effects that go beyond the intervention.

The aim of the present study was to investigate sustained effects of attentional re-training in the food domain. Specifically, we sought to determine whether the changes in attentional bias for chocolate cues and chocolate consumption observed immediately post-training (Kemps, Tiggemann, Orr, et al., 2014; Werthmann et al., 2014) can be maintained 24 h later and one week later. We used a modified dot probe paradigm to increase or decrease attentional bias for chocolate by directing attention either *toward* ('attend') or *away* ('avoid') from chocolate cues. Following Kemps et al., we examined whether this manipulation altered attentional bias for chocolate, relative to other popular, high-caloric food items that do not contain chocolate (e.g., cake, pizza). We specifically chose items for the comparison control category that were equally attractive (but that did not contain chocolate) rather than more neutral food items to ensure that any attentional bias modification effects could not be attributed to differences in overall appeal between the stimulus categories. The use of two equally desirable food categories thus provides a very clean test of any sustained effect of attentional re-training on consumption. Importantly, we compared the effects of a single versus multiple re-training sessions, because initial investigations into other domains (alcohol, tobacco) suggest that more than one training session may be required to produce sustained effects (Fadardi & Cox, 2009; Field et al., 2009; Schoenmakers et al., 2010).

2. Method

2.1. Participants

A sample of 160 undergraduate students were recruited from Flinders University, Adelaide, South Australia, via online and poster advertisements. To preclude possible gender effects on attentional bias and consumption (Havermans, Giesen, Houben, & Jansen, 2011), participation was restricted to female students who liked chocolate. Participants received course credit or an honorarium in lieu of their time and commitment. Eleven participants withdrew from the study at varying time points. The final sample ($N = 149$) was between 18 and 37 years old ($M = 20.22$, $SD = 2.56$) and mostly of normal weight. Mean BMI was 23.44 ($SD = 5.24$). Participants consumed on average 1.89 ($SD = 1.67$) chocolate bars and 3.13 ($SD = 2.95$) chocolate-containing food items per week.

2.2. Design

The experiment used a 2 (group: attend, avoid) × 2 (sessions: single, multiple training) × 4 (time: pre-test, post-test, 24-h follow-up, one-week follow-up) mixed factorial design. Participants were randomly assigned to the group × sessions conditions. Participant numbers for each of these conditions were: attend/single ($N = 37$), attend/multiple ($N = 39$), avoid/single ($N = 38$) and avoid/multiple ($N = 35$).

2.3. Materials

The stimuli for the modified dot probe task were 98 digital coloured photographs comprising 35 pictures of chocolate or chocolate-containing food items (e.g., chocolate bar, brownie) and 63 pictures of highly desired food items not containing chocolate (e.g., cake, pizza). All pictures were scaled to 120 mm in width, whilst maintaining the pictures' original aspect ratio. Two sets of stimulus pairs were constructed: critical (chocolate − non-chocolate) and control (non-chocolate − non-chocolate), consisting of 35 and 14 pairs, respectively. Within each pair, pictures were matched according to ratings of perceptual characteristics, pleasure, arousal, and category representativeness, obtained through pilot testing (Kemps, Tiggemann, Orr, et al., 2014). The 35 critical (chocolate − non-chocolate) pairs were divided into five subsets, each comprising seven pairs. Two of these subsets were used at pre-test and training. To increase generalizability, at each of the post-test and follow-up assessments, a combination of one previously seen and one new subset was used. Allocation of subsets to the pre-test and training phases versus the post-test and follow-up phases was counterbalanced across participants and conditions. Another 14 picture pairs, featuring non-food related content (e.g., car, beach ball), were created for practice and buffer trials.

2.4. Procedure

As an extension of standard attentional bias modification protocols (Field & Eastwood, 2005), the modified dot probe procedure consisted of five phases: (1) a pre-training baseline assessment of participants' attentional bias for chocolate (pre-test), (2) a training phase in which half the participants were trained to attend to chocolate, and the other half were trained to avoid chocolate, (3) a post-training assessment of participants' attentional bias for chocolate similar to the pre-test (post-test), (4) a 24-h follow-up assessment of participants' attentional bias for chocolate similar to