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Eating behaviour associated with differences in conflict adaptation for food pictures

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ABSTRACT

Objective: The goal conflict model of eating (Stroebe, Mensink, Aarts, Schut, & Kruglanski, 2008) proposes differences in eating behaviour result from peoples' experience of holding conflicting goals of eating enjoyment and weight maintenance. However, little is understood about the relationship between eating behaviour and the cognitive processes involved in conflict. This study aims to investigate associations between eating behaviour traits and cognitive conflict processes, specifically the application of cognitive control when processing distracting food pictures.
Method: A flanker task using food and non-food pictures was used to examine individual differences in conflict adaptation. Participants responded to target pictures whilst ignoring distracting flanking pictures. Individual differences in eating behaviour traits, attention towards target pictures, and ability to apply cognitive control through adaptation to conflicting picture trials were analysed.
Results: Increased levels of external and emotional eating were related to slower responses to food pictures indicating food target avoidance. All participants showed greater distraction by food compared to non-food pictures. Of particular significance, increased levels of emotional eating were associated with greater conflict adaptation for conflicting food pictures only.
Conclusion: Emotional eaters demonstrate greater application of cognitive control for conflicting food pictures as part of a food avoidance strategy. This could represent an attempt to inhibit their eating enjoyment goal in order for their weight maintenance goal to dominate.
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1. Introduction

The goal conflict model of eating proposes that it is the conflict between automatic goals of eating enjoyment and controlled goals of behaviour change that explains rises in obesity and failures in weight-loss maintenance (Stroebe, van Koningsbruggen, Papies, & Aarts, 2013). However little is known about the cognitive processes involved in responding to these conflicting goals. Although research often focuses on conscious, observable behaviours or intentions, there is a need for non-conscious, automatic processes that influence behaviour to be more fully understood (Sheeran, Gollwitzer, & Bargh, 2013). Health behaviour can be manipulated by targeting non-conscious goals or cognitions (Papies & Hamstra, 2010; Wagner, Howland, & Mann, 2015). Further, successful dieters can adapt their cognitive control towards food (DelParigi et al., 2007, 2006; Papies & Hamstra, 2010; Papies, Stroebe, & Aarts, 2008; Stroebe, Mensink, Aarts, Schut, & Kruglanski, 2008). Therefore it is important to understand how we use cognitive control to adapt to conflicting food-related goals.

One factor that influences a person's ability to maintain a healthy eating goal is the high level of food and food-related cues we are exposed to on a daily basis which are associated with differences in both eating behaviour and weight (Burgoine, Forouhi, Griffin, Wareham, & Monsivais, 2014; Cetateanu & Jones, 2014; Grafova, 2008; Kruger, Greenberg, Murphy, DiFazio, & Youra, 2014). These food cues introduce a conflict with some individuals responding to a heighted attentional bias for food that conflicts with their behavioural goal of sustained healthy eating (Herman & Polivy, 2008; Hou et al., 2011). This inability to apply cognitive control in order to ignore distraction by food cues has been

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suggested as a cause of disinhibited eating. Therefore this study will investigate the cognitive processes involved in controlling and adapting to food-related goal conflict by investigating the relationship between eating behaviour traits and the application of cognitive control.

1.1. Eating behaviour and cognition

Eating behaviour traits are representations of cognitive mechanisms that are adopted in response to conscious or unconscious behavioural goals. Restrained eating represents the cognitive restriction of food consumption, emotional eating represents the regulation of behavioural states using food, and external eating represents the motivational drive to consume food triggered by exposure to food cues. When reviewing the research on eating behaviour traits and cognition, the past focus has primarily been directed towards examining the relationship between restrained eating and cognition, specifically executive function and working memory (Jones & Rogers, 2003; Kemps & Tiggemann, 2005). The effects indicate a general cognitive impairment with a reduction in working memory capacity and impaired executive function (Brunstrom, Davison, & Mitchell, 2005; Higgs, 2007; Rogers & Green, 1993; Westenhoefer et al., 2013). More specifically, the ability to modulate attention towards food cues using working memory has been shown to be related to the capacity for an individual to apply effective dietary restraint (i.e. successful dieters) (Higgs, Dolmans, Humphreys, & Rutters, 2015). Findings demonstrate that food cues in particular have a strong effect on the top-down cognitive control processes that guide attention (Higgs, Rutters, Thomas, Naish, & Humphreys, 2012; Rutters, Kumar, Higgs, & Humphreys, 2015).

The literature on external eating and emotional eating behaviours and their connection with cognition, is sparser. There are some studies that have shown an attentional bias towards food cues related to increased external eating (Brignell, Griffiths, Bradley, & Mogg, 2009; Hou et al., 2011; Nijs, Franken, & Muris, 2009). Further, by its nature external eating is associated with an increased motivation to respond to palatable food cues in the environment, thus triggering disinhibited eating (Burton, Smit, & Lightowler, 2007; Kakoschke, Kemps, & Tiggemann, 2015). But alternatively, research has indicated that the attentional bias is driven more by changes in visual and reward-system activation as a result of weight-gain rather than eating behaviour trait (Castellanos et al., 2009; Stoeckel et al., 2008).

There is evidence to suggest that emotional eating is related to both avoidance of distraction and emotion-oriented coping (Spoor, Bekker, Van Strien, & van Heck, 2007). In turn it has been demonstrated that an avoidance orientation strategy enhances sustained cognitive control (Hengstler, Holland, van Steenbergen, & van Knippenberg, 2014). Approach and avoidance could be considered the two most fundamental motivation states, with avoidance motivation a means to prevent us from exposure to danger or negative outcomes (Elliot, 2008). In this instance the negative outcome is weight gain. Separately, research has shown that negative affect is associated with enhanced adaptation to conflict (Schuch & Kock, 2015; van Steenbergen, Band, & Hommel, 2010). Specifically, negative affect influences neural control processes when selecting task-relevant information, thereby reducing distraction (Melcher, Born, & Gruber, 2011). Emotional eating and negative affect are not the same thing, indeed a previous review demonstrated the difficulties around predicting how emotions affect eating (Macht, 2008). But, if this research is taken in combination, it suggests that increased levels of emotional eating may be associated with an avoidance motivation towards food and increased adaptation to conflicting goals for the food specific tasks.

1.2. Modulation of cognitive control

This study uses a flanker task (Eriksen & Eriksen, 1974) to focus on the cognitive conflict experienced when processing multiple food pictures and in particular the ability to adapt to that conflict. In a flanker task, a target stimulus is presented flanked on either side by non-target stimuli. Participants are instructed to make a response based on the target stimulus and to ignore the non-target stimuli. In congruent trials, target and non-target stimuli are the same. In incongruent trials, target and non-target stimuli differ in either the type of stimulus or the response required. Differences in ability to inhibit distraction and adapt to conflict are measured by comparing performance on congruent trials with incongruent trials (Eriksen & Eriksen, 1974; Eriksen & Schultz, 1979). This task differs from those used in previous studies in that it is not a working memory task or a specific task of attention. Instead it focuses on distraction and conflict. Therefore it is not clear if factors such as restraint seen in previous research on working memory and attention (e.g. Higgs et al., 2015; Kemps & Tiggemann, 2005) will also be influential in modulating conflict and cognitive control.

The cognitive process involved in the flanker task is typically explained with dual-route models consisting of a faster, automatic response route and a slower, more controlled route. If these routes trigger the same response (as with congruent trials) no conflict occurs. However if the routes trigger different response alternatives (as with incongruent trials) then the conflict needs to be resolved with top-down cognitive control, inhibiting the fast automatic route and responding with the slower, controlled route The difference in response times between congruent and incongruent conditions (the 'flanker effect') provides an index of the level of cognitive control exerted with larger flanker effects indicating greater distraction due to lower levels of cognitive control being successfully applied.

A second effect is that more cognitive control is applied in a trial if the preceding trial induced a conflict (Egner, 2007). It has been proposed that the application of cognitive control in the preceding trial results in a reduced flanker effect in the subsequent trial because the automatic processing route is inhibited (Clayson & Larson, 2011; Gratton, Coles, & Donchin, 1992; Ridderinkhof, 2002). By examining these trial by trial variations in the application of cognitive control, an individual's ability to modulate the conflict being experienced can be measured.

Support for the successful use of the flanker task comes from both addiction research (Franken, van Strien, Franzek, & van de Wetering, 2007; Luijten, van Meel & Franken, 2011), and from two prior food flanker studies (Forestell, Lau, Gyurovski, Dickter, & Haque, 2012; Meule, Vogele, & Kubler, 2012). Meule et al. (2012) proposed an association between restrained eating and an attentional bias towards food targets (as seen by faster reaction times to the food cues compared to the neutral cues). In contrast, Forestell et al. (2012) found no association between restrained eating and the flanker task performance when participants were satiated. However when hungry, restrained eaters did experience response conflict but only when low calorie food targets were flanked by high calorie distractors. In contrast, unrestrained eaters showed distraction by high calorie flankers for both low and high calorie food targets.

The overall goal of this research is to investigate associations between eating behaviour traits and the application and adaption of cognitive control. In the present study we used a flanker task in which participants were asked to respond to a target picture whilst ignoring flanking pictures, and examined the association between flanker effects and eating behaviour traits. In order to study the specific effects of food, we compared a food condition with a non-food condition. Within each of these conditions four pictures were

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