Effect of inhibitory control training on food-related action tendencies, liking and impulsive choice

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Abstract

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Introduction

The recent rise in overweight and obesity rates can primarily be attributed to the over-consumption of energy-dense foods that are high in fat, sugar and salt content (World Health Organization, 2018). One theoretical explanation for overeating has been provided by dual-process models which argue that behaviour is determined by the interaction of impulsive (*automatic*) and reflective (*controlled*) processes (Kakoschke et al., 2015; Strack & Deutsch, 2004). For example, over-consumption of unhealthy foods can be ascribed to heightened automatic biases for such foods, which can result in increased food intake if these automatic tendencies are not regulated via controlled processes (Kakoschke et al., 2017b).provide example here – e.g. exposure to unhealthy foods in the environ (advertising)

can trigger biased behavior and result in consumption for those who have limited self-control (either

Theoretical frameworks, such as the dual process model, have led to the development of behaviour change interventions for unhealthy eating behaviours that target either automatic or controlled processing, such as approach bias modification and inhibitory control training respectively (see Kakoschke et al., 2017a; Jones, Hardman, Lawrence, & Field, 2018 for recent reviews).

Need to take a step back here and explain ICT- Suggest discussion of inhibition, how it's related to food-related behavior , training and associated effects on behavior. Discuss success in terms of findings and meta-analyses. Provide some key examples from the literature

Rachel's comment below: After discussing ICT and effects on behavior etc. I think we should discuss mechanism of devaluation... and then link to approach/ avoid- Also need to provide some discussion of increased preferences for go foods... whilst appreciating the point that we do not have a cued-approach design (so there are some differences) but the

logic / theory still applies

CUT bit: The primary aim of the present study was to investigate the interaction between automatic and controlled processing in the context of inhibitory control training (ICT). Specifically, we tested whether food-specific ICT could influence individuals' automatic action tendencies towards unhealthy foods.

This study focuses on an automatic process known as approach bias, which is the automatic action tendency to approach an appetitive (food) cue in the environment, rather than avoid it (C. E. Wiers et al., 2013). An approach bias has been demonstrated for a variety of energy-dense foods in both obese and healthy-weight individuals (Brignell, Griffiths, Bradley, & Mogg, 2009; Kemps & Tiggemann, 2015; Kemps, Tiggemann, Martin, & Elliott, 2013; Veenstra & de Jong, 2010). Interestingly, Kakoschke et al. (2015) found that approach bias alone did not predict increased intake of unhealthy foods, but it was the interaction between approach bias and inhibitory control that was the significant determinant of subsequent behaviour. The authors report that approach bias had the expected effect on food intake only for participants with low inhibitory control. An important component of controlled processing is inhibitory control, which refers to the ability to inhibit behaviours and impulses that are incompatible with higher-order goals, such as wanting to lose weight (Houben, Nederkoorn, & Jansen, 2012), and encompasses several elements, such as response inhibition and cognitive flexibility (see Bartholdy, Dalton, O'Daly, Campbell, & Schmidt, 2016). Inhibitory control capacity is often measured via response inhibition paradigms, such as the go/no-go task (Donders, 1969; Newman & Kosson, 1986) and stop-signal task (Lappin & Eriksen, 1966; Logan, Cowan, & Davis, 1984), and has been associated with unhealthy eating behaviours (e.g., Jasinska et al., 2012; Guerrieri et al., 2007; Hall, 2012). For example, Nederkoorn, Houben, Hofmann, Roefs, and Jansen (2010) showed that strong implicit preferences for snacks paired with low "inhibitory control capacity" predicted weight gain over one year. Overall, there is evidence to suggest that both inhibitory control and motivational processes are important

determinants of eating-related behaviour.

Complementary evidence for the role of automatic and controlled processes in the regulation of eating behaviours stems from the line of research dedicated to the development of health behaviour change interventions. Approach bias modification training is commonly delivered via an approach-avoidance task (AAT; Neumann & Strack, 2000; Rinck & Becker, 2007; R. W. Wiers et al., 2013) and has been found to be effective in re-training approach bias for foods (Brockmeyer, Hahn, Reetz, Schmidt, & Friederich, 2015) and even reduce food intake in the laboratory (Schumacher, Kemps, & Tiggemann, 2016; see Kakoschke et al., 2017a for review). The AAT is assumed to capture automatic action tendencies when participants are instructed to respond to task-irrelevant feature such as the orientation (portrait or landscape) of the presented picture, by pulling or pushing a joystick (C. E. Wiers et al., 2013). The AAT can also pair actions with visual feedback, so that the picture gets bigger when participant pull the joystick towards them (zoom-in) and gets smaller when they push it away (zoom-out). Arm extension could indicate an approach response towards an appetitive food (object-reference) or an avoidance response when the food is pushed away from the body/self (Phaf, Mohr, Rotteveel, & Wicherts, 2014) and thus visual feedback provides the self-reference attribute to the responses (e.g., object comes closer to one's body). The "zooming" feature disambiguates the mapping of responses to approach and avoidance actions, whereby pulling the joystick represents approach and pushing it reflects avoidance (Neumann & Strack, 2000). In AAT training, contingencies between actions and stimuli are manipulated so that appetitive cues are associated with push actions (avoidance) and neutral items are paired with pull actions (approach).

In the context of controlled processes, ICT interventions involve cue-specific go/no-go or stop-signal tasks whereby participants are instructed to make a speeded choice response to appetitive stimuli such as foods or alcohol, but to withhold that response when a visual, or auditory, signal is presented. In go/no-go training, signal-stimulus mappings are

manipulated so that appetitive cues (e.g., unhealthy foods) are consistently paired with a stop signal. Stopping to unhealthy foods has been shown to reduce food consumption (Adams, Lawrence, Verbruggen, & Chambers, 2017; Houben & Jansen, 2011, 2015; Lawrence et al., 2015; Veling, Aarts, & Papies, 2011; also see Allom, Mullan, & Hagger, 2016 for meta-analysis) and promote healthy food choices in the laboratory (Veling, Aarts, & Stroebe, 2013; Veling, Chen, et al., 2017). ICT protocols have even been associated with increased weight loss (Lawrence, O'Sullivan, et al., 2015; Veling, van Koningsbruggen, Aarts, & Stroebe, 2014). A potential mechanism of action behind ICT effects on food consumption is stimulus devaluation (Veling et al., 2017), whereby the evaluations of appetitive foods are reduced during training to facilitate performance when response inhibition is required (e.g., Chen, Veling, Dijksterhuis, & Holland, 2016). A possible explanation for this devaluation effect is provided by the Behaviour Stimulus Interaction (BSI) theory which posits that food stimuli are devalued when negative affect is induced to resolve the ongoing conflict between triggered approach reactions to appetitive foods and the need to inhibit responses towards those stimuli (Chen et al., 2016; Veling, Holland, & van Knippenberg, 2008; Veling et al., 2017). When a food is devalued, the approach bias towards that cue is reduced and inhibition can successfully take place. It is possible that this reduction in approach bias can be observed after go/no-go training[1].

Theoretically, the effects of ICT could also be explained by hard-wired connections between Pavlovian appetitive/ aversive centres [dickinson_mechanisms_2014] and go/no-go responses (McLaren & Verbruggen, 2016; Verbruggen, url, Bowditch, Stevens, & McLaren, 2014). Verbruggen et al. (2014) suggest that conditioned inhibitory control in ICT paradigms, such as go/no-go training, can have an influence not only on the evaluations of stimuli, but also their motivational value via links to the appetitive/aversive centres. For example, a stimulus consistently paired with stopping on signal trials would be

[1] It should be noted that a link between affect and motivation is also included in the dual-process framework of (eating) behaviour

devalued and the approach motivation for that stimulus could also be reduced via a hard-wired excitatory connection between the "stop" system and the aversive centre (also see Dickinson & Boakes, 2014; McLaren & Verbruggen, 2016). Similarly, approach bias for foods consistently paired with go responses on no-signal trials could be increased via the link between the "go" system and the appetitive centre.

This study attempts to answer this question by employing a go/no-go training paradigm with unhealthy food stimuli and measuring automatic action tendencies via an AAT before and after training. We tested whether individuals would show reduced approach bias for the foods associated with response inhibition and/or increased approach bias for the foods paired with go responses after training. Consistent with previous ICT literature, the study also examined impulsive food choice and food liking as secondary training outcomes. The research study was conducted as part of the GW4 Undergraduate Psychology Consortium 2017/2018 and data were collected across Cardiff University, University of Exeter and University of Bath campuses.

Methods

Results

Discussion

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