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Is cake more appealing in the afternoon? Time of day is associated with control over automatic positive responses to unhealthy food

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ABSTRACT

Despite researchers considering time of day an important variable in studies on implicit food evaluations and food intake, time of day effects on implicit food evaluations have yet to be tested. Positive implicit evaluations of unhealthy food stimuli measured with an implicit association test (IAT) predict behaviour toward those stimuli, and are assumed to reflect automatic reactions outside of conscious awareness and control. However, recent research has revealed controlled processing to have an influence on IAT performance. The current study tested time of day effects on implicit evaluations of unhealthy food measured with an IAT, and specifically on automatic and controlled processes underlying IAT performance. A sample of 304 undergraduate women aged 17–25 years completed a single-category IAT at varying times of the day. Results revealed that participation later in the day was associated with a more positive implicit evaluation of unhealthy food. This was mediated by a decrease in the ability to inhibit positive food reactions (i.e., controlled processing), rather than an increase in automatic positive reactions. The findings draw attention to the importance of considering time of day in studies measuring aspects of implicit cognition using tasks such as the IAT.

1. Introduction

Evaluations can exert powerful influences on behaviour. In particular, positive implicit evaluations of unhealthy appetitive stimuli such as alcohol, cigarettes, and unhealthy food, have been shown to predict higher desire, craving, consumption, and even longer term health consequences such as weight gain, substance dependence, and alcohol use problems (e.g., Haynes, Kemps, Moffitt, & Mohr, 2014; Houben & Wiers, 2007, 2008; McCarthy & Thompsen, 2006; Nederkoorn, Houben, Hofmann, Roefs, & Jansen, 2010; Waters et al., 2007). Some researchers consider time of day a potentially influential variable in studies on implicit food evaluations and food intake, therefore restricting the time of day at which experiments are conducted (e.g., Hofmann, Friese, & Roefs, 2009; Houben, 2011; Kemps, Tiggemann, Martin, & Elliot, 2013). However, the influence of time of day on implicit food evaluations has not yet been tested. Tasks measuring implicit evaluations are often championed as having advantages over self-report assessments of explicit preferences, because they are assumed to assess automatic reactions to stimuli indirectly, outside of awareness, and are thus not amenable to intentional control (Bargh, Chen, & Burrows, 1996; Dasgupta, McGhee, Greenwald, & Banaji, 2000; Fazio & Olson, 2003). However, controlled processes have also been shown to contribute to performance on implicit tasks. As time of day presents a potential extraneous variable in studies utilising implicit measures of food evaluations, the current paper aimed to explore relationships between time of day and implicit evaluations of unhealthy food measured using an implicit association test (IAT), and with the underlying automatic and controlled aspects of IAT performance.

There are two theories supporting the predicted time of day variations in implicit evaluations of unhealthy food. First, potential variations in implicit food evaluations by time of day could be attributable to social norms or eating appropriateness standards. Time of day has been demonstrated to correlate with food preference and perceived acceptability (Birch, Billman, & Richards, 1984). In particular, consuming unhealthy snack food may be perceived as more appropriate in the afternoon than in the morning, as self-report data suggest that snacking is most common in the afternoon and least common in the morning (Cross, Babicz, & Cushman, 1994). Affective reactions to food may be associatively conditioned to the context in which it is eaten – in this way, a particular type of

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food may be more readily associated with positive affect at the time of day that it is normally eaten, or when consumption is most acceptable (Birch et al., 1984). However, in a study of food selection and consumption, Kramer, Rock, and Engell (1992) found that neither hedonic ratings nor intake of foods were associated with whether the food was presented at a time of day rated as 'appropriate' for consumption of that food. Nevertheless, the acceptability or normality of snack food consumption later in the day could offer a plausible explanation for why we might expect implicit evaluations of unhealthy snack food to become more positive as the day progresses.

Second, the ability or motivation to exert control over automatic responses to stimuli may diminish as the day progresses, which could affect estimates of implicit food evaluations garnered from an IAT. After one act of self-control, subsequent attempts at inhibition become less successful, an effect termed 'ego depletion' (although recent evidence has called into question the replicability and size of this depletion effect; Baumeister, Bratslavsky, Muraven, & Tice, 1998; Carter & McCullough, 2014; Hagger et al., 2015). Some researchers have drawn attention to time of day as a potential proxy for ego depletion due to the after-effects of exerting self-control in response to daily demands (Boland, Connell, & Vallen, 2013; Hofmann, Vohs, & Baumeister, 2012; Kouchaki & Smith, 2013). For example, later in the day individuals are more likely to act immorally, fail at overcoming unhealthy desires, and are more susceptible to unconscious goal priming effects on food intake; effects which have been linked to ego depletion (Boland et al., 2013; Hofmann et al., 2012; Kouchaki & Smith, 2013). Given the contribution of controlled processing to implicit task performance (Payne, 2001) and the requirement of sufficient self-control to enact this type of processing (Deutsch & Strack, 2006), time of day could affect estimates of implicit food evaluations because of diminished control over immediate positive reactions to unhealthy food. Govorun and Payne (2006) found that ego depletion increased implicit racial stereotyping measured using a weapon-identification task for individuals with an automatic racial bias. Further, they demonstrated that ego depletion reduced controlled aspects of task performance (i.e., reduced individuals' ability to control their expression of racial stereotypes in the task), but had no influence on automatic aspects of task performance (i.e., no effect on individuals' automatic racial bias). Likewise, we would expect that unhealthy food IATs completed later in the day would reveal a more positive implicit evaluation of unhealthy food, which would be attributable to a diminished ability to control, rather than a change in, automatic reactions to unhealthy food. Further, later in the day, automatic positive reactions to unhealthy food are likely to be more predictive of IAT scores than earlier in the day, due to this diminished control over automatic reactions to food stimuli.

The current paper sought to explore time of day effects on implicit food evaluations measured with an IAT, and in particular, on estimates of automatic versus controlled components of performance therein. We conducted secondary analyses on IAT data from two studies from our laboratory (Haynes, Kemps, & Moffitt, 2015a, 2015c). These two studies were selected because both samples were administered the same version of the IAT at the beginning of the experimental session, prior to any experimental manipulations. Both studies tested individuals in the morning or afternoon, and only included women aged between 18 and 25 years who were motivated to manage their weight through healthy eating, as individuals with the motivation to manage weight through healthy eating are likely to attempt to control positive responses to unhealthy food. Only women were recruited for the studies, as they have higher levels of food liking and craving than men (Cepeda-Benito, Fernandez, & Moreno, 2003; Zellner, Garriga-Trillo, Rohm, Centeno, & Parker, 1999). We analysed the types of errors individuals made on the IAT using the Process Dissociation Procedure (Payne, 2001; Payne & Bishara, 2009), which provides estimates of the strength of the automatic positive reaction to unhealthy food (automatic estimate), and control over those positive responses (controlled estimate).

We predicted that time of day would be positively correlated with implicit food evaluations, such that participants completing the IAT later in the day would have a stronger positive implicit evaluation of food than individuals completing the IAT earlier in the day. While the eating appropriateness and ego depletion accounts both support the prediction that individuals would evaluate unhealthy food more positively later in the day, the appropriateness account does not provide specific predictions about whether this relationship is attributable to a change in the automatic positive reactions to food, or to one's control over those positive reactions. Therefore, in line with the ego depletion account, we also expected that the relationship between a later time of day and a more positive IAT score would be mediated by a diminished control over automatic positive reactions associated with participating later in the day. Likewise, we expected to observe an interaction between time of day and automatic positive reactions to food in predicting implicit food evaluations. Namely, we expected that the automatic estimate would be more predictive of the IAT score later in the day than earlier in the day. This prediction is again in line with the ego depletion account, as we would expect that control over automatic reactions to stimuli diminishes, allowing those automatic reactions to have a greater effect on IAT performance.

2. Method

2.1. Participants

The sample included 304 women (M age = 19.51, SD = 1.95) recruited from the undergraduate student population at Flinders University. Advertisement materials asked for volunteers who met the following criteria: (a) motivated to manage weight through healthy eating, (b) no food allergies or dietary intolerances, (c) aged between 17 and 25 years, and (d) fluent in English. The majority of participants were first-year psychology student volunteers who participated for course credit (n = 217), while the remainder of the sample (n = 87) was recruited from the wider undergraduate student population, and received a $10 honorarium for participating. Ethics approval was provided by the university's Social and Behavioural Research Ethics Committee.

2.2. Measures

2.2.1. Time of day

Sessions were scheduled to begin on the hour between 9 am and 5 pm. Time of day was coded as a continuous variable expressed as minutes from 12 pm, derived from the timestamp data on the IAT task indicating when each participant started the task. This produced a variable with negative values for individuals participating in the morning, and positive values for those participating in the afternoon.

2.2.2. Hunger

Participants reported their current hunger on a 7-point Likert scale ranging from 1 (*not hungry at all*), to 7 (*extremely hungry*).

2.2.3. Implicit food evaluations

A recoding-free variant of a single category implicit association test (SC-IAT-RF) (Karpinski & Steinman, 2006; Rothermund, Teige-Mocigemba, Gast, & Wentura, 2009) programmed and run using