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Research report

Stimulus control and affect in dietary behaviours. An intensive longitudinal study☆

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ABSTRACT

Background: Dietary behaviours are substantially influenced by environmental and internal stimuli, such as mood, social situation, and food availability. However, little is known about the role of stimulus control for eating in non-clinical populations, and no studies so far have looked at eating and drinking behaviour simultaneously. *Method:* 53 individuals from the general population took part in an intensive longitudinal study with repeated, real-time assessments of eating and drinking using Ecological Momentary Assessment. Eating was assessed as main meals and snacks, drinks assessments were separated along alcoholic and non-alcoholic drinks. Situational and internal stimuli were assessed during both eating and drinking events, and during randomly selected non-eating occasions. Hierarchical multinomial logistic random effects models were used to analyse data, comparing dietary events to non-eating occasions. *Results:* Several situational and affective antecedents of dietary behaviours could be identified. Meals were significantly associated with having food available and observing others eat. Snacking was associated with negative affect, having food available, and observing others eat. Engaging in activities and being with others decreased the likelihood of eating behaviours. Non-alcoholic drinks were associated with observing others eat, and less activities and company. Alcoholic drinks were associated with less negative affect and arousal, and with observing others eat. *Conclusions:* Results support the role of stimulus control in dietary behaviours, with support for both internal and external, in particular availability and social stimuli. The findings for negative affect support the idea of comfort eating, and results point to the formation of eating habits via cue–behaviour associations.

Introduction

Every day, and in an abundance of situations, we find ourselves confronted by stimuli relating to food such as food items in shop displays, advertisements for food, or seeing other people eat. These stimuli are highly relevant, because it has been acknowledged that our dietary behaviours are predominately driven by environmental cues rather than by a motivation to restore energy homoeostasis; or, put another way, that we do not eat because we are hungry, but because we see something or encounter a situation that prompts us to eat (Weingarten, 1985).

This approach to understanding eating and other dietary behaviours including drinking is an example of *stimulus control*; it assumes that external factors (e.g., seeing others eat, seeing food in the environment) rather than internal states (hunger, thirst) influence our dietary behaviours or even make us feel hungry (Sobik, Hutchison, & Craighead, 2005). The present study is a first attempt at providing an integrative approach at describing stimulus control effects on a wide range of dietary behaviours in a non-clinical population – it examines environmental (external) and affective (internal) factors that are associated with eating (both during main meals and between meals) and drinking (both alcoholic and non-alcoholic beverages).

Stimulus control and eating

Stimulus control in eating behaviour is hypothesized to be driven by the automatic processing of food-related cues and/or cognitions (King, 2013; Lowe & Butryn, 2007): it is theorized that individuals can misinterpret their psychological responses to such internal and external food-related cues as signals of biological hunger and respond accordingly (Lutter & Nestler, 2009). External cues may include seeing or smelling food, seeing other people eating, food advertising, or being at a location where one has consumed food in the past; internal cues refer to psychological desires for rewarding experiences or to lessen negative mood states (e.g., eating to

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regulate negative affect, or 'comfort' eating; Parker, Parker, & Brotchie, 2006).

There is good evidence for the importance of external cues in eliciting eating behaviour. For example, Cleobury and Tapper (2014) found external cues to be the most important predictors of eating unhealthy snacks in an intensive longitudinal diary study of overweight and obese adults. Similarly, there is evidence that supports the idea that internal cues such as negative affect motivate us to eat, and it has been suggested that energy-dense foods in particular can serve the purpose of down-regulating negative affective states (Parker et al., 2006). Or, put more simply: that people eat in order to decrease negative effect. It has also been shown that experiencing negative affect increases selective attention to food-related stimuli (Hepworth, Mogg, Brignell, & Bradley, 2010), which might explain this association. However, other research suggests that the association between affect and eating might not be as straightforward, but could in fact depend on internal resources such as self-regulatory capacities (Sproesser, Strohbach, Schupp, & Renner, 2011).

Stimulus control and drinking non-alcoholic beverages

Whereas there is rich literature on the role of external and internal stimuli for eating (both regular meals and snacks between meals) and drinking alcohol (more below), there is comparatively little research on the role of stimulus control for drinking non-alcoholic beverages. One study found that having coffee might be cued by situational factors such as going on a cigarette break (Lane, 1996), and there is some evidence that being exposed to an environment that has non-alcoholic beverages available increases the likelihood of having a non-alcoholic beverage (Tucker, Vuchinich, & Sobell, 1979). Further, it has been suggested that being exposed to drink-related cues such as brand logos activates neural pathways similar to those activated during reward processing, at least in more habitual soft drink consumers (Burger & Stice, 2014). This is in line with evidence from a study on adolescents that found that being in locations (e.g., school) or social situations (e.g., with friends), or being bored, which had previously been associated with soft drink consumption, can all increase the likelihood of the consumption of sweetened drinks (Grenard et al., 2013). However, more research is needed to better understand the role of situational factors in the consumption of non-alcoholic drinks.

Stimulus control and drinking alcohol

Compared to non-alcoholic drinks, there is more research on the role of stimulus control for consuming alcoholic beverages. However, the majority of this research has been conducted in clinical populations and it is unclear whether stimuli are similar between clinical and non-clinical drinkers. Only few studies to date have explored drinking alcohol in non-clinical samples. For example, there is evidence that social drinkers (i.e., people who mainly consume alcohol in social situations) experience higher craving in social situations (Papachristou, Nederkoorn, Corstjens, & Jansen, 2012), which in turn might lead to subsequent alcohol consumption. Social cues such as interacting with friends may also play a role in promoting alcohol consumption in non-clinical populations (Aan Het Rot, Russell, Moskowitz, & Young, 2008). In addition, having alcohol readily available or being in an environment where alcohol is easily obtainable has been shown to increase the likelihood of alcohol consumption (Gruenewald, Remer, & Lascala, 2014). It has further been suggested that in non-clinical populations, alcohol might serve as mood-regulation agent, similar to the effects of calorie-dense food discussed above – i.e., experiencing negative affect makes alcohol consumption more likely, as people might drink to improve negative affect (Kassel, Jackson, & Unrod, 2000; Peacock, Cash, Bruno, & Ferguson, 2015) or as a result of high arousal (Swendsen et al., 2000).

Study aims

Previous studies have examined stimulus control on specific dietary behaviours, but to date, no study has examined the role of external and internal stimuli on a comprehensive set of dietary behaviours. Furthermore, only few studies on stimulus control and eating to date have broken down eating into main meals and snacking, the latter being the type of eating arguably most likely to be affected by situational variables, given that it can be viewed as being more discretionary (Cleobury & Tapper, 2014). In this study, we differentiate between eating during main meal periods (i.e., breakfast, lunch, dinner) and snacking (defined as spontaneous additions to the diet; Nielsen, Siega-Riz, & Popkin, 2002). Snacks are typically higher in energy and lower in nutrient content than meals eaten during main meal times (Gearhardt, Grilo, Dileone, Brownell, & Potenza, 2011). Increased snacking frequency has been associated with obesity (Miller, Benelam, Stanner, & Buttriss, 2013), and snack-dominated meal patterns seem to lead to higher intakes of energy, alcohol, sugars, and sucrose, and lower intake of micronutrients (Ovaskainen et al., 2006).

Previous studies on stimulus control and eating behaviour also tended to rely on retrospective assessments such as food frequency questionnaires (Flint, Cummins, & Matthews, 2013), clinical interviews (Lowe et al., 2009), written food diaries (O'Connor, Jones, Conner, McMillan, & Ferguson, 2008; Verhoeven, Adriaanse, Evers, & De Ridder, 2012), or laboratory experimentation and/or observation (e.g., Werthmann et al., 2011), but it has been argued that such methods lead to under-reporting of food intake, particularly snacks (Heitmann & Lissner, 1995). Ecological momentary assessment (EMA; Shiffman, Stone, & Hufford, 2008) procedures – where participants record events in real-time as they go about their day-to-day life – allow researchers to study behaviours in more detail, in real-world settings, and close to real-time. EMA methods to assess food intake have been used previously in eating-disordered populations (Norton, Wonderlich, Myers, Mitchell, & Crosby, 2003), but only few studies so far have used EMA in non-clinical populations (Grenard et al., 2013; Hofmann, Adriaanse, Vohs, & Baumeister, 2013; Thomas, Doshi, Crosby, & Lowe, 2011). In this study, we aim to examine dietary behaviours close to real-time and within the environment in which the behaviours are performed, thus providing a more ecologically valid approach to examining stimulus control of eating and drinking including a wider range of dietary behaviours than previous studies. Further, as previous work has been mainly conducted in clinical samples, our study targeted a non-clinical sample from the general population.

Method

We employed EMA methods to study eating patterns in a community sample. Participants carried a programmable electronic device throughout the day and logged episodes of eating and drinking as well as responded to randomly-timed non-eating/non-drinking prompts. This allows comparing the presence and intensity of a range of internal and external stimuli between consumption logs and random prompts (Shiffman et al., 2014). With training, participants can be highly compliant with such procedures (Schüz, Walters, Frandsen, Bower, & Ferguson, 2014).

Participants and procedure

For this longitudinal intensive assessment EMA study, 53 participants (41.51% female) aged 18–60 years ($M = 28.17$ years, $SD = 11.15$) with a BMI range between 17.7 and 37 ($M = 23.9$,