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# Derailing the streetcar named desire. Cognitive distractions reduce individual differences in cravings and unhealthy snacking in response to palatable food

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ABSTRACT

People who are sensitive to food temptations are prone to weight gain and obesity in food-rich environments. Understanding the factors that drive their desire to eat is key to limiting their reactions to available food. This study tested whether individual differences in sensitivity to hedonic food cues are cognitively based and, accordingly, can be regulated by blocking cognitive resources. To this end, one lab study (Study 1; N = 91) and one field study (Study 2; N = 63) measured sensitivity to hedonic food cues using the Power of Food Scale (PFS; Lowe et al., 2009) and assessed participants' appetitive responses to high-calorie food options. To test the role of cognitive elaboration of food cues, participants completed a menu-selection task to induce food cravings and then were free to elaborate those cravings (control group) or were blocked from doing so by cognitive distraction (playing Tetris, solving puzzles; experimental group). Compared to non-sensitive participants, sensitive participants displayed a greater attentional bias to high-calorie food (Study 1), reported stronger cravings (Study 2), and more often chose an unhealthy snack (Studies 1 & 2), but only when they had not been distracted. When distracted, all participants were similarly unresponsive to high-calorie food. This finding suggests that temptation can be effectively controlled by blocking people's cognitive resources, even for people highly sensitive to hedonic food cues.



A dominant approach in explaining hedonic consumption is to assume that controlling cravings requires willpower. Good intentions are hard to achieve in the face of temptation because limited-capacity cognitive control is needed to prevent immediate rewards, desires and emotions driving behavior (Hofmann, Friese, & Strack, 2009; Loewenstein, 1996; Zajonc, 1984). Self-control has thus traditionally been depicted as a struggle between impelling forces and restraining forces that respectively map onto affective reactions on the one side, and cognitive processes on the other side (Hofmann & Van Dillen, 2012). An alternative view is that such a clean distinction cannot be made, because affective reactions themselves are shaped by cognition (Lazarus, 1991; Schachter & Singer, 1962), a view that is supported by accumulating evidence that cognitive loads reduce affective responses (Bishop, 2009; Van Dillen & Koole, 2007; Van Dillen, Van der Wal, & Van den Bos, 2012).

These competing views raise questions about why some people seem more prone to craving and indulging. Do these people have stronger drives, or weaker willpower, or different cognitive processes? To address this question, we focused on the problem of food attractions, because, in modern food-rich societies, people need to regulate their food intake in order to maintain a healthy weight. Individuals differ in their sensitivity to food attractions in the environment and this so-called sensitivity to hedonic food cues is a critical determinant of dietary health (Lowe & Butrin, 2007), as it drives impulsive eating (McManus & Waller, 1995). Individuals high on sensitivity to hedonic food cues moreover experience frequent thoughts, feelings and urges about food in the absence of actual food deprivation (Van Dillen, Papies, & Hofmann, 2013). In one study, for example, baseline differences in sensitivity to hedonic food cues measured by the Power of Food scale (Lowe et al., 2009)

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predicted self-reported cravings as well as subsequent consumption in students given transparent boxes of chocolates to keep with them but not eat for 48 h (Forman et al., 2007). An important question, given the debate on the nature of food cravings, is whether individuals with high sensitivity to hedonic food cues experience a stronger 'visceral' response (Loewenstein, 1996) to food temptations or whether they differ in their cognitive response, with greater attention to and elaboration of hedonic food cues and thoughts than other people, as predicted by Elaboration Intrusion theory (EI theory; Kavanagh, Andrade, & May, 2005; May, Andrade, Kavanagh, & Hetherington, 2012; May, Kavanagh, & Andrade, 2014) and related motivated cognition models (Hofmann & Van Dillen, 2012).

In Elaborated Intrusion theory, limited-capacity cognitive processes create and maintain the desires that drive consumption. Environmental or physiological factors may trigger thoughts about consumption, but those thoughts only become cravings that direct behavior when they are cognitively elaborated (see for a similar perspective Hofmann & Van Dillen; 2012). According to EI theory, we respond to desirable objects and thoughts by imagining the pleasure of indulging (May, Andrade, Panabokke, & Kavanagh, 2004), and strive towards long-term goals by imagining their achievement and mentally contrasting that state with our present state (Oettingen, Mayer, & Thorpe, 2010). Cognitive processes and emotions are thus part of the same, single, embodied motivational system. Unfortunately for good intentions, it is one that favors immediate rewards because imagining the imminent pleasure of indulging immediate temptations is easier than imagining satisfying long-term goals of health or wealth.

If affective responses that drive hedonic consumption are, at least in part, cognitively interpreted, as EI theory suggests, this may have practical implications for the development of interventions that address self-control goals such as maintaining a healthy diet. Rather than strengthening restraining forces, interventions may be directed at weakening impelling forces, for example by disrupting cognitive elaborations in response to an attractive stimulus. A growing number of studies has examined this idea, and has demonstrated that blocking people's mental resources interferes with attention to attractive food options (Van Dillen et al., 2013), as well as (naturally occurring) food cravings (Kemps & Tiggeman, 2010; Skorka-Brown, Andrade, & May, 2015; Skorka-Brown, Andrade, & May, 2014; Skorka-Brown, Andrade, Whalley, & May, 2015; Van Dillen et al., 2013), and, accordingly, with craving-induced consumption choices (Van Dillen et al., 2013). Evidence moreover includes findings that competing visual or olfactory loads are particularly effective (e.g., Kemps & Tiggeman, 2007; Knäuper, Pillay, Lacaille, McCollam, & Kelso, 2011; May, Andrade, Panabokke, & Kavanagh, 2010; Versland & Rosenberg, 2007), that attention diversion also weakens cravings (Hamilton, Fawson, May, Andrade, & Kavanagh, 2013), and high working memory loads do so more than low working memory loads (Van Dillen et al., 2013).

However, previous studies of cognitive interference with cravings are usually restricted to measurements of craving itself (e.g., Skorka-Brown et al., 2014), or examine the effects of working memory loads on the attentional capture by attractive food cues (Van Dillen et al., 2013). Where effects on consumption have been measured, findings are mixed and difficult to resolve because the methodologies of these naturalistic studies vary considerably from the laboratory studies that preceded them (Hsu et al., 2014; Kemps & Tiggemann, 2013; Knäuper et al., 2011; Skorka-Brown et al., 2015). Little is known, moreover, about individual variability in these effects. Several important questions remain unanswered. The present study addresses those questions: 1. Are individual differences in cue-provoked craving, or sensitivity to hedonic food cues, mediated by cognitive processes? 2. Do reductions in cue-provoked cravings brought about by cognitive interference lead to reduced consumption? 3. Do laboratory findings generalize to cravings in real-world settings? Thus, the present research sought to explain not only whether cognitive processes underpin the experience of desire, but also whether those processes contribute to individual differences in desire and desire-related behavior and how this extends beyond the laboratory.

We addressed these questions by testing the impact of a high visuospatial cognitive load on responses to food temptations in individuals differing in sensitivity to hedonic food cues, first in the laboratory and then in the field. Study 1 used attentional biases to food cues as an outcome measure, because tempting cues draw attention readily and involuntarily (Kavanagh et al., 2005; Kemps, Tiggemann, & Grigg, 2008; Papies, Stroebe, & Aarts, 2008). Cognitive elaboration maintains a cycle of craving by increasing attentional biases, which in turn increase intrusive thoughts and trigger further elaboration. In drug addiction, neurobiological sensitization to rewarding drug cues (Robinson & Berridge, 2003) is expressed behaviorally as attentional biases to those cues (Franken, 2003). When people are cognitively loaded, moreover, hedonic food cues do not preferentially capture their attention, and no longer result in enhanced cravings and hedonic consumption later on (Van Dillen et al., 2013). Attentional biases can therefore considered a marker of proneness to craving, rather than an index of craving itself. We tested whether individuals high in sensitivity to hedonic food cues would show increased attentional biases towards appetitive food cues following an initial craving induction, and if so, whether these biases were stronger when the working memory processes underpinning willpower and restraint were diminished, or whether they became weaker when they could not be sustained through cognitive elaboration, as EI theory would predict (Kavanagh et al., 2005).

Typical studies of cognitive processes in craving have induced cravings in the laboratory and assessed the impact of cognitive loads on those induced cravings. Rather little research has tested whether cognitive loads also weaken cravings in the field. Skorka-Brown et al. (2014) reported that playing Tetris reduced the strength of naturally occurring cravings in the laboratory, without using a craving induction procedure, and four published studies have tested the effects of cognitive interference on food cravings over extended time periods in the field. Knäuper et al. (2011) and Hsu et al. (2014) showed that neutral visual imagery reduced craving strength, and Kemps and Tiggemann (2013) showed reductions in craving when participants watched a dynamic black and white visual display, and Skorka-Brown et al. (2015) found that playing Tetris for 3 min reduced craving. Findings on food consumption in these studies were mixed: Kemps and Tiggemann reported that visual interference reduced calorie intake, Hsu et al. found that neutral visual imagery reduced unhealthy snacking, but Skorka-Brown et al. and Knauper et al. did not find effects on consumption. One explanation for these mixed findings is that the studies relied on self-report of consumption, which can be unreliable (as Skorka-Brown et al. found).

No field studies to date have tested the impact of cognitive craving interference on food choice directly. Study 2 therefore tested the impact of cognitive distracter tasks on actual snack choice as well as craving of train commuters. It thus extended Study 1 by testing whether individual differences in sensitivity to hedonic food cues are similarly regulated by cognitive distractions in more naturalistic settings, which is an important question for designing effective interventions.

## 1. Study 1

Study 1 tested the hypothesis that hedonic sensitivity and episodes of craving are both the result of cognitive processing of food