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A Cognitive Experimental Approach to Understanding and Reducing Food Cravings

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ABSTRACT – Food cravings are a common everyday experience. Yet, they can pose significant health risks for some people. Following initial investigations into the phenomenology, antecedents and consequences of food cravings, recent scientific interest has turned to the underpinnings of the actual craving experience itself. In this article, we outline a conceptual framework for studying food cravings that is grounded in cognitive experimental psychology, along with our corresponding program of research. In particular, we present converging evidence from a number of seemingly disparate lines of research into the cognitive processes that underlie food cravings with a view to developing a craving-reduction technique.

KEYWORDS – craving; food; imagery; cognitive resources; craving reduction

The term “craving” is used to describe the strong motivational state which compels an individual to seek and ingest a particular substance, usually drugs. More recently, however, the term has become increasingly applied to food, as illustrated in the title of Marion Hetherington’s 2001 book: “Food cravings and addiction”. Thus food cravings refer to an intense desire or urge to eat a specific food. It is this specificity which distinguishes food cravings from ‘ordinary’ hunger. We crave a particular chocolate bar, rather than food in general, and often do so in the absence of hunger. Indeed, chocolate is one of the most commonly craved foods in Western society, particularly by women (resulting in the popular term “chocoholic”), along with chips, pizza, cake and ice-cream.

Most of us experience food cravings on occasion, and these are not necessarily pathological. However, like cravings for cigarettes, alcohol, caffeine or drugs, they can pose significant health risks for some individuals. In particular, food cravings have been shown to trigger binge eating episodes, which in turn, contribute to both obesity and disordered eating, especially bulimia nervosa, increasingly serious problems for Western societies. In addition, food cravings can give rise to feelings of guilt and shame if followed by unwanted consumption.

While the earliest record of food cravings dates back to the late 17th century when Martin Lister described the chocolate cravings in Parisian women as “a false hunger” (Hetherington, 2001), psychological interest in food cravings is relatively recent. Initial investigations focused primarily on documenting the phenomenology, antecedents and consequences of food cravings, such as the incidence of naturally-occurring food cravings, and emotional and environmental triggers of food craving (e.g., feelings of boredom or depression, and the sight or smell of food) (for a review, see Hill, 2007). More recent research, however, has focused on the actual craving

experience itself. In this article, we describe a program of research that adopts a cognitive experimental approach to the study of food cravings. In particular, we present evidence from a number of separate yet inter-related strands of research into the cognitive underpinnings of food cravings with a view to developing a craving-reduction technique. In so doing, we do not subscribe to any one particular theory, but rather outline a conceptual framework that is based on well-known robust cognitive experimental phenomena.

NATURE OF FOOD CRAVINGS: A ROLE FOR MENTAL IMAGERY

There is converging evidence from a number of sources, including our laboratory, pointing to mental imagery as a key component of cravings. Specifically, when people crave they have vivid images of the craved substance, so-called “images of desire” (May, Andrade, Panabokke & Kavanagh, 2004). Generalising from findings on nicotine craving, Green, Rogers and Elliman (2000) were the first to experimentally show that instructing participants to imagine a food-related scenario (“Imagine you are eating your favourite food”) can successfully induce food cravings. Subsequently, we (Harvey, Kemps & Tiggemann, 2005) found that the strength of participants’ craving was related to the vividness with which they imagined this scenario. Additionally, surveys of everyday food cravings show that respondents readily use imagery terms (e.g., “I could picture the pizza in my mind”) when describing craving episodes (Tiggemann & Kemps, 2005). Moreover, they strongly endorse imagery descriptors in the visual and olfactory (e.g., “I am visualising the food” and “I imagine the smell of the food), but not auditory, modalities. Similar findings have been reported for cravings for other substances, including tobacco and alcohol (May et al., 2004). Finally, a recent theoretical account of cravings, the

elaborated intrusion theory of desire, proposes that sensory images resulting from the elaboration of intrusive thoughts about the target are at the very heart of the craving experience (Kavanagh, Andrade & May, 2005).

Beginning in the late 1960s, cognitive psychologists have mounted an argument that the phenomenological experience of mental imagery is amenable to the methods of experimental cognitive psychology (for a review, see Richardson, 1999). In particular, dual-task studies (e.g., randomly generating numbers from 1 to 10 while mentally rotating imagined objects) have shown interference (in both directions) between mental imagery and other tasks, indicating that they compete for the same cognitive resources. Taking this one step further, the cognitive study of mental imagery has begun to be applied to clinical phenomena. A recent special issue of the journal *Memory* (July, 2004) edited by Emily Holmes and Ann Hackmann emphasises the significance of mental imagery in the treatment of a variety of psychopathologies, including post-traumatic stress disorder, agoraphobia, body dysmorphic disorder and mood disorders.

FOOD CRAVINGS CONSUME LIMITED COGNITIVE RESOURCES

From the accumulating evidence that (a) food cravings are imagery based, and (b) mental imagery takes up cognitive resources, it logically follows that food cravings may disrupt cognitive task performance. Preliminary initial support came from Green et al.'s (2000) finding that dieters were slower in a simple reaction time task when they had been instructed to imagine eating their favourite food.

Our study (Kemps, Tiggemann & Grigg, 2008) sought to corroborate this response slowing during food craving episodes, and further to test the logical more general extension that experimentally-induced food cravings should reduce working

memory capacity. Working memory capacity refers to the ability to actively store information while simultaneously processing other information (Engle, 2001), and was assessed by the operation span task. In this task, participants are required to remember a series of words while also solving mathematical equations. We induced chocolate craving by a more naturalistic and ecologically valid procedure, whereby participants (instructed not to eat chocolate for 24 hours) were asked to select their favourite from an attractively-presented basket of fun-sized wrapped chocolate bars, to unwrap it and place it and the wrapper on a small tray positioned in view (and smell) below the computer monitor, and indicate how much they liked the chocolate. A manipulation check of self-reported craving confirmed, not surprisingly, that this procedure did indeed induce craving for chocolate. Participants then performed the operation span task in the presence of the chocolate bars. The control group were presented with a basket of similar-size coloured wooden blocks and analogously asked to choose their favourite colour. As can be seen in Figure 1, among habitual chocolate cravers, participants exposed to the chocolate cues (craving induction group) demonstrated slower reaction times (Experiment 1) and recalled fewer words and showed slower mathematical equation solution times in the operation span task (Experiment 2) than the control group.

Slowed reaction times and working memory decrements have also been found in smokers who crave a cigarette (Sayette & Hufford, 1994; Zwaan & Truitt, 1998). These impairments, like those arising from food cravings, are consistent with the view that desire-related images generated during a craving episode take up limited cognitive resources, leaving fewer available for competing cognitive demands. This interpretation which focuses on the limited nature of cognitive resources is consistent with a number of contemporary theoretical models of craving, namely elaborated

intrusion theory (Kavanagh et al., 2005), incentive salience theory (Robinson & Berridge, 1993) and Tiffany's (1990) cognitive model of drug craving. More broadly, it also fits well with Baumeister's model of ego depletion, in which the exertion of self-control draws on a limited consumable resource (e.g., Baumeister, Vohs & Tice, 2007).

Although cognitive effects of individual food craving episodes are likely to be small, in practice even small reductions in cognitive resources have the potential to compromise optimal task performance in many everyday situations, thereby reducing work efficiency or increasing accidents. For example, speeded responding to a visual probe (as in a reaction time task) is vital in vigilance tasks, such as inspecting items on an industrial production line, or manoeuvring through dense traffic, whereas working memory capacity is involved in a wide range of complex skills, such as language comprehension, note taking and following directions.

REDUCTION OF FOOD CRAVINGS

A handful of studies to date have attempted to reduce food cravings. These have generally shown that contemporary craving reduction strategies, such as thought suppression (trying not to think about the craved food) or cue exposure response prevention (presenting an individual with the craved food but not allowing them to eat it), have not proved very successful. Thus there is a need to seek new and different craving-reduction techniques.

The above findings of mutual competition between (the imagery associated with) food cravings and cognitive tasks for limited cognitive resources give rise to one intriguing possibility. Specifically, just as cravings have been shown to reduce cognitive task performance, then conversely (following the logic of dual-task

methodology), it may be possible to use cognitive tasks to reduce cravings. Clearly this constitutes a radically different approach from previous techniques.

More specifically, one would expect tasks that place demands on the same cognitive processes as those that support craving-related imagery, and thus introduce competing information in the same sensory modality, to prove the most effective in reducing craving. We know from more general cognitive psychological research that competing visual tasks interfere selectively with visual imagery, whereas competing verbal tasks interfere specifically with auditory imagery (Richardson, 1999). As we have argued that food cravings are characterised predominantly by visual and olfactory images, with little involvement of auditory images, we would thus predict that a competing visual or olfactory task would reduce food cravings relative to a comparable auditory task.

In our study (Kemps & Tiggemann, 2007), participants were randomly assigned to one of three imagery conditions: visual, auditory and olfactory. After craving induction, participants were asked to form a series of images of common sights (e.g., “Imagine the appearance of a rainbow”), sounds (e.g., “Imagine the sound of a siren”), or smells (e.g., “Imagine the smell of eucalyptus”). Pilot testing ensured that the images evoked by these cues were equally vivid across conditions. As predicted, the visual and olfactory imagery tasks reduced reported cravings for food in general (Experiment 1) and for chocolate in particular (Experiments 2 and 3), in a way that the auditory task did not (see Figure 2 for Experiment 3 results).

In an analogous study, Versland and Rosenberg (2007) showed that imagery scripts that asked smokers to focus on the sights and/or smells associated with being on a beach similarly reduced cigarette cravings. Thus it appears that visual and

olfactory imagery tasks offer potential scope for reducing cravings in general, and for reducing food cravings in particular.

However, forming a series of visual or olfactory images and holding them in mind is not only an elaborate but also a cognitively effortful procedure, and hence unlikely to prove a practical craving reduction technique. Instead, for greater acceptability, we need simpler, relatively undemanding tasks. Accordingly, we decided to adopt a simple visual paradigm derived from experimental analogues of post-traumatic stress disorder. These have shown that merely watching a flickering pattern of random black and white dots, termed dynamic visual noise (similar to snow on an untuned television screen), can successfully reduce the vividness and consequent emotional impact of distressing images.

In our investigations, we (Kemps, Tiggemann & Hart, 2005; Kemps, Tiggemann, Woods & Soekov, 2004) have cued food craving by asking participants to form images of highly desired foods (e.g., chocolate, cake, pizza), and then hold these in mind while watching a dynamic visual noise display. In some experiments images have been elicited by pictures of foods, in others they were generated from verbal cues. As predicted, dynamic visual noise reduced the vividness of participants' food images in a way that a control condition or an auditory equivalent, irrelevant speech (i.e., listening to a recording of a newspaper article read in a foreign language), did not. More importantly, there was also a concomitant reduction in participants' level of craving for these foods (see Figure 3 for data from Kemps et al., 2005). Thus, engaging in a simple visual task seems to hold real promise as a method for curbing food cravings.

FUTURE DIRECTIONS

The next step will be to test the applicability of this cognitive approach to the management and treatment of problematic and maladaptive cravings and eating. In particular, weight-loss dieting is often associated with an increased occurrence of food cravings, which in turn has been implicated in early dropout from weight-loss programs. As obesity rates continue to rise, there will likely be an increasing number of people dieting and trying to lose weight, and correspondingly, an increasing number of people trying to resist or ameliorate food cravings. An important challenge ahead of us will be to investigate whether simple cognitive tasks such as dynamic visual noise can indeed help individuals to control unwanted cravings during dieting attempts. In an encouraging initial attempt, we (Kemps, Tiggemann & Christianson, 2008) showed that dynamic visual noise was a more effective technique for reducing food cravings in a community sample of overweight women on a prescribed weight reduction diet than was suppressing thoughts about food.

Although reducing food cravings is important in its own right, as cravings can be aversive and engender feelings of lack of control, a further and related challenge will be to determine whether the proposed craving reduction mechanism can actually modify eating behaviour – in other words, reduce food intake. Although the link between cravings and subsequent consumption is a topic of considerable debate, it is widely accepted that food cravings can, and do, drive food consumption. An important future direction will be to examine the influence of our experimental craving modification on the relationship between craving and consumption behaviour. In addition, the longevity of the craving reducing effect remains to be empirically tested.

We have suggested that, in practice, a simple dynamic visual noise manipulation might be a more readily accepted craving reduction technique than the

more cognitively demanding act of visualisation. It is certainly likely to be more acceptable to individuals with problematic cravings than either thought suppression or cue exposure response prevention. Real-world implementations could incorporate the dynamic visual noise display into existing accessible technologies, such as the smart phone and other mobile, hand-held computing devices.

Finally, throughout we and others (Green et al., 2000; May et al., 2004) have argued for an underlying cognitive psychological commonality between cravings for food and those for other substances (both legal and illegal). Although food differs from these other substances in that biologically we all have to eat, for some people unwanted food cravings can be just as distressing and compelling as cravings for cigarettes, alcohol or other drugs. Hence the cognitive experimental approach presented here may have broader implications and utility beyond the food and eating domain.

CONCLUSION

In this article, we have outlined a conceptual framework for understanding and reducing food cravings, together with our corresponding program of research. The underlying logic of the premises that (1) mental imagery is a key element of food craving, (2) mental imagery takes up cognitive resources, and (3) similar modality cognitive tasks disrupt mental imagery, is simple but elegant. These premises are themselves well-grounded in cognitive experimental research. More generally, we offer a concrete demonstration of how mainstream experimental cognitive psychology can be usefully applied to the study of an important and pressing clinical and health issue.

Recommended reading

Hetherington, M. M. (Ed., 2001). (See References). A comprehensive volume

outlining biological and psychological perspectives on food craving.

Hill, A.J. (2007). (See References). A brief review of psychological research on food craving.

Holmes, E.A., & Hackmann, A. (Eds., 2004). Mental imagery and memory in psychopathology. *Memory*, 12 (whole no. 4). Hove, UK: Psychology Press. A special issue that contains a collection of papers discussing the role of mental imagery in a wide range of psychological disorders.

Kavanagh, D., Andrade, A., & May, J. (2005). (See References). This paper describes a recent cognitive model of craving (the elaborated Intrusion theory of desire) that assigns a central role to mental imagery.

Richardson, J.T.E. (1999). (See References). A comprehensive overview of the history of cognitive psychological research into mental imagery.

Acknowledgements and end note

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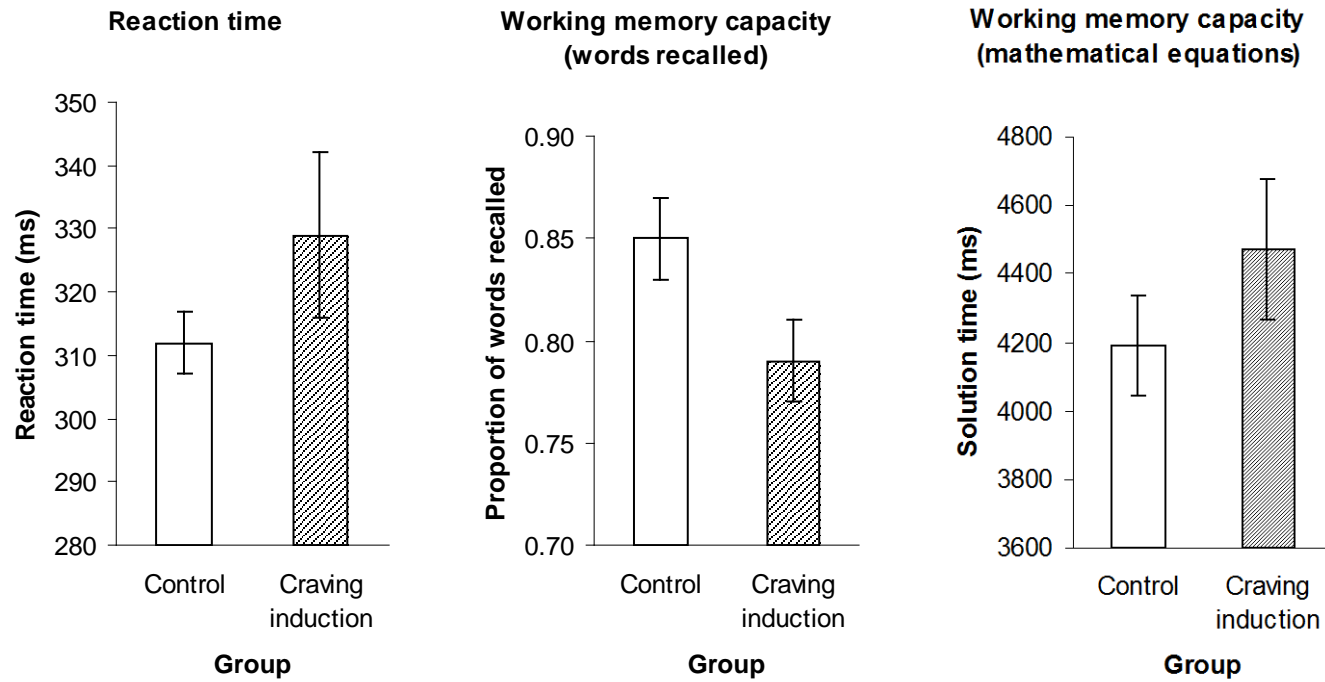


Fig. 1. Reaction times, word recall and mathematical equation solution times of habitual chocolate cravers exposed to chocolate (craving induction group) or not (control group) (adapted from Kemps, Tiggemann & Grigg, 2008). Error bars represent one standard error.

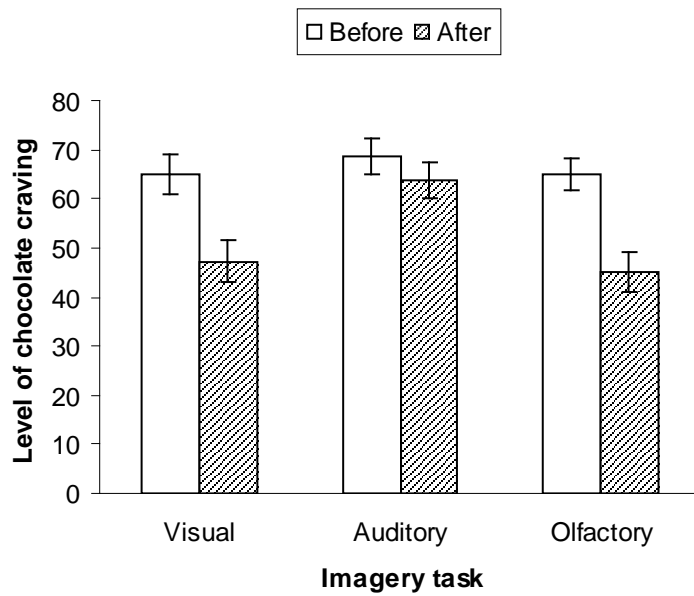


Fig. 2. Chocolate craving before and after imagining a series of non-food cues in the visual, auditory or olfactory modalities (adapted from Kemps & Tiggemann, 2007). Craving was rated on a scale ranging from 0 (= no desire or urge to eat) to 100 (= extremely strong desire or urge to eat). Error bars represent one standard error.

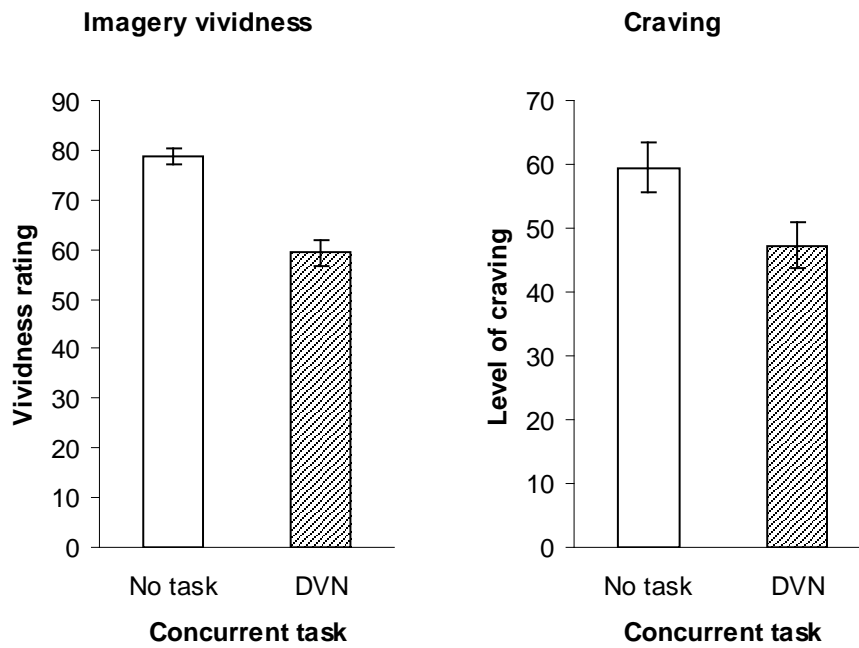


Fig. 3. Imagery vividness and level of food craving while watching dynamic visual noise (DVN) compared to a no-task control condition. Imagery vividness and craving were rated on scales ranging from 0 (= no image at all) to 100 (= image perfectly clear and vivid), and 0 (= no desire or urge to eat) to 100 (= extremely strong desire or urge to eat), respectively. Error bars represent one standard error.