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Associations between nutritional properties of food and consumer perceptions related to weight management

Nicola J. Buckland [a,*], Michelle Dalton [a], R. James Stubbs [b], Marion M. Hetherington [a], John E. Blundell [a], Graham Finlayson [a]

[a] University of Leeds, School of Psychology, Leeds LS2 9JT, England, United Kingdom
[b] University of Derby, Psychology, Kedleston Road, Derby DE22 1GB, England, United Kingdom

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ABSTRACT

Consumer perceptions of food (for example, how filling or healthy) influence eating behaviour and appetite control. Therefore approaches to understand the global nutritional attributes of foods that predict the strength of consumer perceptions are of academic and commercial interest. The current research describes the development of a flexible platform for systematically mapping the global nutritional attributes of foods (both objective and perceived) to consumer perceptions of those foods. The platform consists of a database of standardised UK food images (currently $n = 300$), linked to a catalogue of detailed perceptual, nutritional, sensory, cost, and psychological information ('nutritional attributes'). The platform also incorporates demographic and psychometric questionnaires to examine the importance of nutritional attributes on consumer perceptions within or between relevant target groups. In the current study, the platform was applied to a sample of dieting and non-dieting British men and women ($n = 887$) to examine the global attributes of a subset of foods ($n = 75$) and their association with successful weight management (i.e. supportive of weight loss, weight loss maintenance or prevention of weight gain). Generalised linear models identified energy density, cost (£/kcal), perceived energy content and satiating capacity as the main nutritional attributes underlying dieters' and non-dieters' perception of successful weight management food. Additionally, pleasantness, and desire not to (over) eat were uniquely associated with dieters' perception of food as good for weight management; pleasantness was positively associated with weight management and desire to eat was negatively associated with weight management. Therefore, global nutritional attributes of foods can predict and distinguish the extent consumers' perceive a food to be related to successful weight management. This platform will be extended to increase the variety of foods and specificity of nutritional attributes in the database suitable for a range of commercial, academic or clinical research applications.

1. Introduction

Consumer perceptions of foods vary on a number of dimensions such as healthiness (Ross & Murphy, 1999), taste (Raghunathan, Naylor, & Hoyer, 2006), satiating capacity (Oakes, 2006) and freshness (Oakes & Slotterback, 2002). Such perceptions can influence food selection (Steptoe, Pollard, & Wardle, 1995) and energy intake (Buckland, Finlayson, & Hetherington, 2013; Capaldi, Owens, & Privitera, 2006; Provencher, Polivy, & Herman, 2009). For instance, consuming preloads perceived as meals reduced young adults' subsequent test meal intake compared to consuming preloads perceived as snacks (Capaldi et al., 2006; Pliner & Zec, 2007). Perceptions about foods can also reduce food intake. Buckland et al. (2013) found that eating food perceived to be congruent with weight loss goals reduced dieters' subsequent meal intake compared to an equi-caloric food associated with hedonic goals. As perceptions of food play a role in the choice and amount of food consumed, it could be valuable to systematically explore which common dimensions of foods contribute to the strength of consumer perceptions to facilitate healthy eating choices.

Existing research on food perceptions have mostly explored determinants of foods perceived as 'healthy'. Participants report perceived freshness (Oakes & Slotterback, 2002) and perceived fat content (Carels, Harper, & Konrad, 2006; Carels, Konrad, & Harper, 2007; Oakes & Slotterback, 2001a, 2002; Rizk & Treat, 2014) to be most important in their association with health. Two studies have also examined the perception that foods can influence

* Corresponding author.
E-mail address: n.j.buckland@leeds.ac.uk (N.J. Buckland).

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weight loss. Participants reported that they perceive foods as strongly associated with weight loss if they are low in fat, low in energy content, high in satiating capacity and high in protein (Carels et al., 2006, 2007). However, such findings on the perception of weight loss foods are based on studies including only 16 foods (Carels et al., 2006, 2007) and the generalizability of these findings to a wider range of foods is currently unclear.

Perceptions about foods is an important issue given that governments are calling for consumers to focus on the proactive prevention of avoidable disease by taking more responsibility for their own health through the adoption of healthier lifestyles, improved diets, increased physical activity and managing their own weight (HM Government, 2010; U.S. Department of Health and Human Services, 2010). There is interest in developing and marketing functional foods to manage satiation, satiety and body weight (for example, Blundell, 2010). According to the EC guidance (EFSA Panel on Dietetic Products, 2012; European Parliament, 2006) claims relating to appetite and energy balance are classified as health claims if they refer to "slimming or weight control or a reduction in the sense of hunger or an increase in the sense of satiety or the reduction of the available energy from the diet" (European Parliament, 2006). The EC specifically notes that such claims need to be based on scientific substantiation "by taking into account the totality of the available scientific data, and by weighing the evidence" (European Parliament, 2006). A systematic map of the global nutritional attributes of foods (both objective and perceived) in relation to consumer perceptions and experience of those foods could contribute to the evidence base for foods to manage satiation, satiety and body weight.

Individual differences also seem to play an important role in the perception of foods. One example is gender (Oakes & Slotterback, 2001a, 2001c; Rappoport, Peters, Downey, McCann, & Huffcorzine, 1993; Slotterback & Oakes, 2000). Fat content tends to be more important to women than men in their perception of healthiness (Oakes & Slotterback, 2001a). Age can also influence food perceptions, with younger participants naming freshness and unprocessed attributes as important for healthiness, whereas older participants focus more on fat and energy content (Oakes & Slotterback, 2001b). Previous research also suggests that being on a weight management diet can affect how some foods are perceived. For example, when asked which dimensions affect the perception of weight loss foods, those on a diet were more likely to refer to low sugar (Carels et al., 2007), low energy, fat and sodium content (Oakes, 2006) compared to participants not dieting.

However, most research exploring food perceptions have relied on participants' self-report of what factors determine their perceptions (for example, Carels et al., 2006, 2007; King, Herman, & Polivy, 1987; Oakes & Slotterback, 2001, 2002). However, perceptions of an attribute of food (such as satiating capacity) are not always congruent with the objectively measured strength of the attribute (Green & Blundell, 1996). Furthermore, perceptions of food may be influenced by other sources of information, even if unknowingly. For example, Oakes (2006) found that protein content across a range of foods was associated with their perceived satiating capacity, yet open ended questions asking participants why they thought a food was high in satiating capacity failed to reveal this. Thus, it seems that the perception of foods is complex and can be influenced by cues outside consumers' awareness (Cohen & Babey, 2012). Relying on consumers' reports, about a limited range of foods, as most research has done, may not be sufficient to reveal the true combination of attributes that determine how a food is perceived. It is also important to note that the majority of previous studies have used names or written descriptions of foods to explore perceptions (for example, King et al., 1987; Oakes & Slotterback, 2002). Yet, carefully prepared images of foods are likely to be more ecologically valid and may have different effects on how food perceptions are formed. Food images provide much richer information compared to words and as such they elicit physiological responses such as increased heart rate (Drobes, Miller, & Hillman, 2001) and psychological responses such as increased motivation to eat (Ouwehand & Papies, 2010). Images then are more likely to reflect the situation (physiological and psychological) people will be in when they are forming food perceptions in the real world. Furthermore, few studies have explored the role of branding, packaging and pricing on perceptions about foods (Cavanagh, Kruja, & Forestell, 2014) and a flexible platform which allows these factors to be explored needs to be developed.

The current research describes the development of a platform to map the global attributes (nutritional, sensory, psychological) of a large range of systematically sampled foods onto consumer perceptions of those foods. Furthermore, because individual differences may affect food perceptions, the platform incorporates demographic and psychometric profiles of respondents to examine the importance of nutritional attributes on consumer perceptions between relevant groups (e.g. dieters and non-dieters). For the purposes of this paper, 'food perceptions' is used as a general term which can refer to sensory or cognitive perceptions and their associated meaning as held by consumers about foods.

In this initial demonstration, the platform was used to examine the global food attributes that determine the consumer perception of foods that promote successful weight management in a sample of dieting and non-dieting adults. The perception of foods associated with successful weight management is important in part because perception may assist dieters to meet diet-related goals by directing food choices and reducing energy intake (Buckland et al., 2013). Therefore, it was of interest to explore how the perception of foods may differ between dieters and non-dieters.

The objectives of this study were to: (i) map nutritional attributes to consumer perceptions of a large database of food images; (ii) examine which global attributes predict the perception of foods as supportive of successful weight management and; (iii) test whether the perception of successful weight management foods differs according to current dieting status.

2. Methods

2.1. Food image database

Foods were sourced from a UK supermarket and were prepared, weighed (to nearest 0.1 g) and photographed at the Human Appetite Research Unit, University of Leeds according to standardised operating procedures. To minimise the impact of packaging and branding on perceptions all foods were photographed without packaging or branding information.

The database for the present study consisted of 300 different foods comprising of snack and meal foods appropriate to different eating occasions (for example, breakfast, lunch, dinner) and formats (for example, entrees, desserts, snacks), presented as either single or compositional foods (for example, salmon fillet with rice and vegetables). The foods varied on a number of other dimensions including taste (i.e. sweet, bland, savoury), energy content, macronutrient content, portion size (recommended serving/large serving) and cost (low/high).

Foods were photographed in colour using a Sony NEX-F3 camera. All foods were photographed under laboratory controlled conditions such that light exposure, background, and image composition were controlled. Foods were arranged on a white plate (circumference: 21.5 cm) unless the food was a food typically served in a bowl (for example, soup or porridge). Foods typically eaten from a bowl were arranged in a glass bowl (circumference: 15.5 cm, height: 6 cm) and the glass bowl was placed in the centre