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Research report

Increasing food familiarity without the tears. A role for visual exposure?

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ABSTRACT

Research has established the success of taste exposure paradigms as a means of increasing children's acceptance, and liking, of previously unfamiliar or disliked foods. Yet, parents report that they tend to avoid the stress associated with repeatedly offering their children foods that are likely to be rejected. Given that successful taste exposure programmes often enhance children's familiarity with a food's appearance, as well as its taste, this article reviews the potential for exposure interventions that do not require repeated tastings to bring about positive attitude changes towards healthy foods. Recent evidence from studies that expose toddlers to picture books about fruit and vegetables suggest that familiarity with the origins and appearance of unfamiliar foods might increase children's willingness to accept these into their diets.

Introduction

The close relationship between an individual's eating habits in childhood, adolescence and adulthood (Ashcroft, Semmler, Carnell, van Jaarsveld, & Wardle, 2008; Devine, Connors, Bisogni, & Sobal, 1998; Kelder, Perry, Klepp, & Lytle, 1994; Nicklas, Webber & Berenson, 1991; Nicklaus, Boggio, Chabanet, & Issanchou, 2004, 2005; Skinner, Carruth, Bounds, Ziegler, & Reidy, 2002) has led researchers and practitioners to explore techniques for increasing children's fruit and vegetable consumption from an early age. Current estimates suggest that preschool children consume only 70% of the recommended daily allowance of fruit and vegetables and that only one in five children achieve five portions a day (Cockroft, Durkin, Masding, & Cade, 2005; Gibson, Wardle, & Watts, 1998; Joint Health Surveys Unit, 2009; NHS Information Centre, 2009). Vegetable consumption is especially low in young children. In 1995, Buttriss reported that little more than half of preschoolers ate boiled vegetables such as peas and carrots; only 39% consumed leafy green vegetables and 24% raw vegetables. Little has changed since then. According to the recent National Diet and Nutrition Survey, preschoolers eat an average of 74 g of vegetables per day, less than one adult portion (Bates, Lennox, & Swan, 2010); in some regions of the UK, as many as 40% of pre-schoolers eat no vegetables at all (Cockroft et al., 2005).

In light of these statistics, this review explores the extent to which increasing young children's familiarity with vegetables might be employed as a means of boosting their vegetable consumption. We consider the impact of repeatedly exposing a child to a food's taste, an established means of enhancing acceptance of a food (Birch & Marlin, 1982). However, we also explore the influence of food familiarity more generally, such as the benefits associated with hands-on experience of growing vegetables in school gardens (e.g. Heim, Stang, & Ireland, 2009; Morris and Zidenberg-Cherr, 2002). The review discusses the impact of familiarising a child to a food's non-taste properties, with a particular focus on prior exposure to a food's visual appearance (Addessi, Galloway, Visalberghi, & Birch, 2005; Dovey, Staples, Gibson, & Halford, 2008; Tuorila, Meiselman, Bell, Cardello, & Johnson, 1994). Finally, we describe our recent and ongoing research into the impact of exposure to pictures of fruits and vegetables on toddlers' willingness to taste them (Heath, Houston-Price, & Kennedy, 2010; Houston-Price, Hill, Kennedy, & Owen, 2010; Houston-Price, Burton, et al., 2009; Houston-Price, Butler, & Shiba, 2009) and we discuss the potential for an intervention based on visual exposure to facilitate efforts to increase children's vegetable consumption.

Food neophobia and fruit and vegetable intake

Attempts to increase children's fruit and vegetable intake face a number of barriers, such as children's innate dislike of bitter and sour tastes (Steiner, 1979), including the taste of bitter vegetables (Forestell & Mennella, 2007) and their 'food neophobia', the tendency to reject unfamiliar foods without tasting them (Raudenbush & Frank, 1999). Neophobia is not to be confused with 'food fussiness' or 'pickiness', which causes some children to reject a

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wide range of both familiar and unfamiliar foods; picky eaters tend to have a highly restricted diet, which may persist into adulthood (Dovey et al., 2008; Galloway, Fiorito, Lee, & Birch, 2005; Wardle & Cooke, 2008). In contrast, neophobia is a specific distrust of unfamiliar foods (Raudenbush & Frank, 1999) that typically peaks at 2 years of age and persists until 4–6 years (Cashdan, 1994; Cooke, Wardle, & Gibson, 2003). During the preschool years, almost all children display neophobic behaviour towards fruits and vegetables (Addessi et al., 2005; Birch & Fisher, 1998; Birch, Gunder, Grimm-Thomas, & Laing, 1998; Cashdan, 1994, 1998; Cooke et al., 2003; Greenhalgh et al., 2009). However, neophobia is a heritable trait, meaning that some children exhibit higher levels than others (Cooke, Haworth, & Wardle, 2007; Knaapila et al., 2007). Cooke, Carnell, and Wardle (2006) estimate that highly neophobic preschoolers have a fruit and vegetable intake that is 35% lower than that of low neophobic children.

Food neophobia is generally thought to be an adaptive mechanism that humans share with other animals to protect them from potentially harmful substances (Rozin, 1976); once a child is sufficiently mobile to be able to find and consume objects in his or her environment without parental guidance, neophobia works to prevent the ingestion of potentially toxic chemicals (Birch et al., 1998; Cashdan, 1998; Wright, 1991). Findings of neophobic behaviour in a variety of animal species, including non-human primates (Visalberghi & Addessi, 2000) and rats (Rozin, 1976), support an evolutionary perspective on the origins of neophobia. Further support for this view comes from reports that neophobia is especially evident towards vegetables of the brassicaceae family (such as cabbages, broccoli and brussel sprouts) and citrus fruits, plants whose non-fruit parts (such as leaves) contain poisonous compounds that are difficult to break down (Glander, 1982).

Neophobia can be overcome by consuming the unfamiliar food. The evolutionary account of this process is that the 'learned safety' of a food that is consumed without aversive consequence allows it to be accepted into the consumer's diet (Kalat & Rozin, 1973). However, while a single 'safe' exposure to a food solution is sufficient for a rat to overcome its distrust of a new food, children's natural wariness of unfamiliar foods appears to abate more gradually, following repeated tastings (Birch & Marlin, 1982; Birch, McPhee, Shoba, Pirok, & Steinberg, 1987). Some have therefore argued that knowledge of a food's safety is not the only factor driving the child's acceptance of previously rejected foods. Alternative accounts of the reversal of the neophobic response include 'flavour–flavour learning', whereby children come to accept a new food by associating it with already known and liked flavours (Havermans & Jansen, 2007), and 'flavour–nutrient learning', whereby children accept a food after experiencing the positive consequences of absorbing its micronutrients (Havermans, 2010).

However, it is worth noting that neophobic behaviour is not restricted to the domain of unfamiliar foods. According to Bronson (1972), infants exhibit ambivalent reactions towards many new objects, their natural interest in engaging with their environment conflicting with their fear of the unfamiliar. Adults have also been shown to exhibit a negative response to new stimuli experienced through a variety of senses (including auditory, visual and olfactory stimuli; Monahan, Murphy, & Zajonc, 2000; Perlman & Oskamp, 1971; Zajonc, 1968). In the same way that repeated taste exposures to foods reduce children's neophobia, the adult aversion to novelty is also reported to diminish through repeated encounters. In fact, 'mere exposure', the sub- or supraliminal perception of a stimulus, is sufficient to engender a more positive attitude towards it (Zajonc, 1968). It is therefore possible that taste exposures enhance children's liking of a new food in a similar manner, simply by increasing the food's familiarity (Cooke, 2007).

The impact of taste exposure on children's food uptake

Researchers have therefore investigated whether offering children repeated tastes of an unfamiliar food might be employed as an intervention to enhance their acceptance, and even liking, of previously rejected foods. There is considerable support for the success of such tasting regimes (Birch & Marlin, 1982; Birch et al., 1987, 1998; Busick, Brooks, Pernecky, Dawson, & Petzoldt, 2008; Forestell & Mennella, 2007; Lakkakula, Geaghan, Zanovec, Pierce, & Tuuri, 2010; Liem & de Graaf, 2004; Loewen & Pliner, 1999; Pliner, 1982; Sullivan & Birch, 1990; Wardle, Cooke, et al., 2003; Wardle, Herrera, Cooke, & Gibson, 2003; Williams, Paul, Pizzo, & Riegel, 2008). For example, Birch and Marlin (1982) provided 2-year-old children with up to 20 opportunities to taste unfamiliar cheeses or fruits over a four-week period and found that 10 or more tastes of the food resulted in increased acceptance of it. Similarly, Sullivan and Birch (1990) demonstrated that 4- and 5-year-olds' preference for sweet, salted or plain tofu could be manipulated by asking children to taste one of the tofu products on 8–15 occasions. Such laboratory findings translate well to more naturalistic settings. Increases in preschoolers' and primary school-aged children's liking and consumption of vegetables have been shown to result from both parent-led and school-based taste exposure programmes (e.g. Lakkakula et al., 2010; Wardle, Cooke, et al., 2003).

On the basis of such research, 10–15 taste exposures (or a daily tasting for a fortnight) have been proposed to be optimal for eliciting liking of a previously unfamiliar food in preschool-aged children. However, the majority of studies into the beneficial effects of taste exposure have involved children between the ages of 2 and 6 years, who are potentially highly neophobic. The very large numbers of taste exposures that research has found to be required to elicit liking of an unfamiliar food may, therefore, be associated with the onset of food neophobia in the second year; infants might be more accepting of new flavours and textures during the weaning period, when neophobia levels are comparatively low. Studies have produced mixed findings on this issue. Forestell and Mennella (2007) reported that eight exposures to the taste of green beans were sufficient to bring about an increase in consumption of this vegetable in 4- to 8-month-old infants. In the same age group, Birch et al. (1998) found a dramatic increase in intake of a never-before-tasted fruit (banana) and vegetable (peas) after only a single exposure to the target food. Nevertheless, a significant positive linear trend was observed in infants' consumption of the food with additional exposures, and by the tenth exposure, Birch et al. noted that consumption had more than doubled compared to baseline, suggesting that the optimal number of exposures may, in fact, be similar in infants and toddlers.

While the benefits of repeated taste exposure are evident, there can be difficulties in implementing the necessary taste opportunities in the home environment. Some parents exhibit food neophobia or eat only a restricted variety of foods themselves and, as a consequence, provide only a limited range of foods for their child to eat (Carruth & Skinner, 2000; Wardle, Carnell, & Cooke, 2005). Even for parents who are well-intentioned about introducing their child to a varied and healthy diet, it can be difficult to persuade a reluctant toddler to try an unfamiliar or disliked food. In the case of unfamiliar foods, parents may mistakenly interpret a child's reaction to a novel food as an indication of the child's dislike of the food, and remove it from the child's diet as a result (Carruth & Skinner, 2000; Carruth, Ziegler, Gordon, & Barr, 2004). Carruth and Skinner (2000) reported that parents are generally unwilling to coerce their child into tasting a food if they believe this is likely to result in 'bothersome behaviour'.

The evidence suggests that it may, in fact, not be advantageous to try too hard to persuade a child to taste a novel food. Tuorila and