



Sensory evaluation of a novel vegetable in school age children



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ABSTRACT

A behavioural sensory task was undertaken to further understanding into whether children's sensory evaluation of a new vegetable is associated with tasting and food neophobia scores. A sample of ninety-five children, aged 7–11 years, was recruited from a primary school in inner city Birmingham, UK. They were asked to rate the sight, smell and feel of a familiar vegetable (carrot) and an unfamiliar vegetable (celeriac) in a randomised order to control for order effects. They were then asked to try the each vegetable, and rate its taste. It was found that children rated the sensory characteristics of the familiar vegetable more positively than the novel vegetable across all sensory domains ($p < 0.05$). Refusing to try the novel vegetable was associated with food neophobia scores and olfactory ratings. The ratings of the taste of the novel vegetable were associated with olfactory and tactile ratings. In addition there was a clear developmental shift in the sample with younger children being more likely to rate the novel vegetable as 'looking strange' and older children rating the novel vegetable as 'smelling strange'. This research strengthens the idea that sensory information is important in children deciding to try, and their hedonic evaluation of the taste of a new vegetable.

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1. Introduction

The promotion of a healthy diet in children inevitably needs to address the problem of adequate fruit and vegetable (FV) consumption. Diets high in fruit and vegetables have been shown to be important for long term health outcomes, and are believed to reduce the likelihood of certain cancers, cardiovascular disease, type II diabetes and obesity (e.g. Dauchet, Amouyel, Hercberg, & Dallongeville, 2006; Hu et al., 2000; Liu et al., 2000; Tang, Lee, Su, & Binns, 2014). Despite large public health campaigns promoting the consumption of FV, it has been repeatedly found that children eat below the five portions recommended by the UK government and global health organisations (Health Survey for England, 2007; 2008; National Diet and Nutrition Survey, 2014; World Health Organisation, 2003).

Vegetables are the least consumed (National Diet and Nutrition Survey, 2014) and least liked food group in children (Cooke et al., 2004) and are the most wasted in school canteens (Alejandra, Begona, Jesus, Gaspar, & Eduardo, 2014; Morizet, 2011).

Researchers have stated the importance of separating out fruit and vegetable consumption due to the fact that fruits are sweet, and therefore inherently preferred, compared to the often bitter taste of vegetables (Birch, 1999; Osbourne & Forestell, 2012). This idea is further supported by a number of recent intervention studies which have recorded a preference for fruits over vegetables in relation to child intake, tasting and liking (Houston-Price et al., 2009; Heath, Houston-Price, & Kennedy, 2014; Osbourne & Forestell, 2012), leading to the suggestion that research should examine these two food groups separately (Osbourne & Forestell, 2012).

There are a number of potential factors which may contribute to the formation of child eating behaviours and in particular a low intake of vegetables. For example parental strategies such as high parental control (Wardle, Carnell, & Cooke, 2005) and inadequate exposure opportunities (e.g. Dazeley, Houston-Price, & Hill, 2012; Howard, Mallan, Byrne, Magarey, & Daniels, 2012) are likely to interact with child factors such as food neophobia (Coulthard & Blissett, 2009), resulting in reduced intake. Food neophobia, defined as the reluctance to try new foods (Pelchat & Pliner, 1995), has been hypothesised to be a protective biological mechanism which inhibits the consumption of bitter tasting and unfamiliar foods that could potentially be poisonous or contaminated (Martins & Pliner, 2006). The theory of the *Omnivore's Dilemma* proposes

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that we need a variety of foods for optimal health, but we also need to avoid being poisoned (Martins & Pliner, 2005). In the modern food environment, where we have learnt what foods may be safely consumed, the biological trait of food neophobia is still associated with a lower frequency of dietary variety in children (e.g., Cooke et al., 2004; Galloway, Lee, & Birch, 2003), and with a lower acceptance of vegetables in particular (van der Horst, 2012). The process of exposure, or repeated tasting, is the most common strategy to overcome the neophobic food response (Wardle et al., 2005). It is believed to be effective through the process of 'learned safety' formed through multiple ingestions without adverse consequences (Rozin & Kalat, 1971). The problem with young children in the height of the neophobic stage is that they tend to reject foods, in particular vegetables, on sight without tasting (Birch, McPhee, Shoba, Pirok, & Steinberg, 1987).

Recent theories of neophobia in children have proposed that the rejection of new foods may be based an intuitive, fast, automatic system of processing of the visual features of foods (Maratos & Staples, 2015). Dovey et al. (2012) looked at developmental differences between children and adults in their sensory evaluation of a novel fruit, Guava, rated in a fixed order of domains (visual, olfactory, tactile and taste). They found that visual evaluation of a novel fruit was the most important predictor of consumption in 5–10 year olds, whereas adults tended to decide to taste a novel fruit based on evaluation in the tactile domain. The importance of visual appraisal of foods in children is recognised in the literature, and has been integrated into FV interventions (Houston-Price et al., 2009). In addition to this, research has found that other sensory domains may also be important in children's evaluation of novel foods, in particular tactile processing, (Coulthard & Thakker, 2015; Nederkoorn, Jansen, & Havermans, 2015; Werthmann et al., 2015) and olfactory processing (Coulthard & Blissett, 2009; Monnery-Patris et al., 2015). Furthermore increasing familiarity through sensory education and exposure across a variety of senses has been found to reduce food neophobia scores in children (Mustonen & Tuorila, 2010; Reverdy, Chesnel, Schlich, Köster, & Lange, 2008; Dazeley & Houston-Price, 2015).

1.1. Rationale and hypotheses

There is increasing evidence that the sensory evaluation of foods is crucial in determining acceptance and rejection in children (Coulthard & Thakker, 2015; Dovey et al., 2012; Houston-Price et al., 2009; Mustonen & Tuorila, 2010). Therefore, we need to gain a deeper understanding of how children evaluate new foods, in particular which sensory characteristics of foods are they attending to when making their decisions to reject. The aim of the present study was to extend understanding in this area by examining hedonic sensory evaluation of a novel vegetable, compared to a familiar and liked vegetable in children. As familiarity and learned safety are important factors, it is expected that children will rate a familiar vegetable more positively than a novel vegetable across all sensory domains (tactile, visual, olfactory, taste). Another aim of this study is to examine whether sensory evaluation in the different domains will predict both the decision to try, and subsequent evaluation of the taste, of the novel vegetable. Based on previous literature (Dovey et al., 2012; Maratos & Staples, 2015), we expect children to base their decisions to try on the visual characteristics of the vegetable.

2. Method

2.1. Participants

The sample consisted of ninety-five children, who were

recruited from a primary school situated in an inner city area of Birmingham, United Kingdom. Children were recruited on the basis that parents reported that they were familiar with carrot as a vegetable, but they had not eaten the novel vegetable, celeriac. There were 46 girls and 49 boys in the sample, aged from 7 to 11 years with a mean age of 9.36 (*SD* 1.08) years. The sample was ethnically diverse, with 18 children classified as White-British, 7 children from an African Caribbean heritage, 52 from a south Asian background (38 Pakistani, 11 Indian and 4 Bangladeshi), 10 children were from a mixed heritage background. A further 7 children were of other ethnic origins, such as African or European. The percentage of children eligible for free school meals was 28.3%, which is similar to rates in the West Midlands as a whole (27%, Department of Education Statistics, 2013).

2.2. Design

This was an experimental design, using a within participants' methodology. All children were offered the familiar vegetable (carrot) and the novel vegetable (celeriac), and were asked to evaluate their smell, touch and sight in a counterbalanced order.

2.3. Materials

2.3.1. Food Neophobia Scale for Children (FNS-C, Galloway et al., 2003)

The FNS-C is a six item self-report measure for children, which measures food neophobia, or the reluctance to eat new foods. It includes six items which have been adapted from the Child Food Neophobia Scale (Pliner & Hobden, 1992), a parental report measure, to create a self-report scale for children. Items include, 'It is scary to eat a food I have never tried before' and 'If I don't know what is in a new food, I won't try it'. The scale, though not widely used as the parental version, has good reliability ($\alpha = 0.86$), and was found to be associated with vegetable intake and parental food neophobia in 7 year old girls (Galloway et al., 2003). In the present study, internal reliability was acceptable ($\alpha = 0.68$).

2.3.2. Behavioural evaluation task

Preparation of the vegetables took place in a university food laboratory. Raw pieces of carrot and celeriac were cut into uniform small cubes (2 cm), and stored in an airtight container shortly before the testing session. A separate portion of a similar sized cube was kept separately in a sealed Tupperware box for tasting after the sensory evaluation procedure, and these were kept separately from the other vegetable stimuli. One cube of carrot and celeriac were placed into separate opaque plastic cups immediately prior to data collection in the testing room at the school. The cups were opaque to minimise visual information during the olfactory and tactile evaluation tasks. A trained sensory panel of six participants, who were familiar with both vegetables (carrot and celeriac) judged the two vegetables on their differences according to 6 sensory characteristics on a 100 ml scale: colour (consistency of colour) texture (firmness, crunchiness), smell (strength), and taste (bitterness, sourness, sweetness). It was found that the celeriac was rated as having a stronger smell than the carrot, but there were no differences across the other sensory parameters.

The behavioural task consisted of 3 sensory evaluation procedures described below, the order of which was counterbalanced to eliminate order effects.

1. Tactile evaluation

Children were asked to put their hand inside the container at arms-length and without looking inside and feel the piece of

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