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Research report

Exposure to foods' non-taste sensory properties. A nursery intervention to increase children's willingness to try fruit and vegetables ☆

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ABSTRACT

Activities that engage young children with the sensory properties of foods are popular with nursery schools, despite the lack of evidence for their efficacy in increasing children's consumption of healthy foods. This study provides the first empirical exploration of the effectiveness of a non-taste sensory activity program in a nursery school setting. Ninety-two children aged between 12 and 36 months were allocated either to an intervention group, who took part in looking, listening, feeling and smelling activities with unusual fruits and vegetables every day for 4 weeks, or to a non-intervention control group. In a subsequent mealtime taste test, children touched and tasted more of the vegetables to which they had been familiarized in their playtime activities than of a matched set of non-exposed foods. The results demonstrate that hands-on activities with unfamiliar fruits and vegetables can enhance children's willingness to taste these foods, and confirm the potential for such activities to support healthy eating initiatives.

Introduction

Infants' taste preferences are initially determined by innate predispositions such as a liking for sweet tastes (Desor, Maller, & Andrews, 1975; Desor, Maller, & Turner, 1973), which is assumed to provide an evolutionary benefit by identifying calorific foods (Wardle & Cooke, 2008). Additionally, children commonly demonstrate a reluctance to taste unfamiliar foods as they approach the age of 2 years; this 'food neophobia' (Cooke, 2007; Rozin, 1976) is thought to protect the child from ingesting potentially harmful substances as they become able to explore their environment more independently. Both these instinctive behavioral patterns decrease the likelihood that children will develop a liking of a wide variety of healthy foods, particularly vegetables, which often have a bitter taste.

Considerable work has shown that familiarizing young children with the taste of an unfamiliar or disliked food is an effective means of increasing their acceptance of it (Birch, 1999); between 10 and 15 taste exposures are generally found to be required (Birch & Marlin, 1982; Gerrish & Mennella, 2001; Wardle et al., 2003a; Wardle, Herrera, Cooke, & Gibson, 2003b). While it is often assumed that the active component of such exposure interventions is the repeated tasting of the food, and the 'learned safety' that results from this (Kalat & Rozin, 1973; Rozin, 1976), the act of tasting is not an isolated sensory experience as it also provides exposure to the food's non-taste sensory qualities. That is, when a food is offered to a child to eat, the child is exposed to the sight of the food, its smell and its texture as the food is handled; he or she may also hear the name of the food. If they taste it, they additionally experience the texture of the food in the mouth and the sound it makes as it is chewed. Familiarity with these non-taste sensory properties of a food may play some part in the positive effects that result from repeated tasting.

Research suggests that, despite its evidential success, repeatedly offering children foods to taste is not a technique widely used by parents at home; 80% of caregivers are only prepared to offer their child a new food three or four times before they will decide that their child does not like it, on the basis of the child's 'bothersome behavior' (Carruth, Ziegler, Gordon, & Barr, 2004). Parents may find it easier to provide repeated exposure to the non-taste properties of foods, especially if this occurs outside mealtimes in an environment that does not carry the stress associated with ensuring that the child is consuming a healthy diet. There is therefore value in exploring the potential for non-taste familiarization to facilitate the introduction of new foods.

Nursery schools in the UK are increasingly signing up to multisensory activity programs that seek to encourage healthy eating by

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familiarizing toddlers and preschoolers with the sensory qualities of food. Popular programs include *Ella's Explorers* (Ella's Kitchen, 2011) and *Taste for Life* (Organix, 2010), developed from the methods proposed in a range of *Mange Tout* books (Thomas, 2007). While these programs are based on the personal experiences of the authors rather than academic theory or evidence, the activities have proven very popular and several thousand nurseries have adopted them into their daily curriculum. There are therefore good grounds to think that non-taste activities involving fruits and vegetables would be welcomed by parents and caregivers, should the evidence confirm that these activities do indeed support healthy eating.

To date, little research has investigated the role played by the individual non-taste senses in children's food acceptance (see Dazeley, Houston-Price, & Hill, 2012 for a review). There is encouraging evidence to suggest that visual and olfactory exposure can promote consumption (Bronstein & Crockett, 1976; Fedoroff, Polivy, & Herman, 1997; Heath, Houston-Price, & Kennedy, 2014; Hennessy, Smotherman, & Levine, 1977; Houston-Price, Butler, & Shiba, 2009), although olfactory exposure is yet to be explored as a means of increasing fruit and vegetable intake in young children. The effects of familiarization with the texture and/or sound qualities of fruit and vegetables have not, as yet, been investigated.

A small body of work has looked into the effects of holistic sense-based interventions with school-aged children aged between 6 and 11 years. For example, *Le goût de l'enfant* classes educate children to use their senses when eating and drinking (Puisais & Pierre, 1987); a 'taste' lesson might teach children to discriminate between drinks with or without added sugar, for example. The popularity of the program has led to its translation from French to Swedish (Hagman & Algotson, 2000), and there is some evidence of effectiveness. In one study, parents reported that children's eating behavior was less neophobic after they participated in the *Le goût de l'enfant* classes and that they had tried a wider variety of foods than a control group (Mustonen & Tuorila, 2010). However, a study that followed children up 10 months later found that children's neophobia levels and willingness to taste novel foods had returned to baseline levels by this point (Reverdy, Chesnel, Schlich, Köster, & Lange, 2008).

It is difficult, however, to build hypotheses about the likely success of sense-based activities with nursery-school-aged children on the basis of this work. While Mustonen, Rantanen, and Tuorila (2009) reported that it was the children at the younger end of the 6- to 11-year-old age range targeted by the *Le goût de l'enfant* classes who benefited most from participation, there has, to date, been no investigation into the effectiveness of sensory activities designed for pre-schoolers. Yet, the first few years of life are critical for developing life-long food preferences (Harris, 2008), and sensory interactions with foods at an early age may have a profound and lasting impact on eating habits.

Second, the *Le goût de l'enfant* program does not specifically target healthy foods, and so may or may not increase consumption of the food groups promoted in healthy eating guidelines, such as fruits and vegetables. Additionally, the lack of appropriate control groups in many studies of the *Le goût de l'enfant* program complicates interpretation of their findings. Given the known impact of socio-economic and demographic factors on children's diets (Whichelow & Prevost, 1996), it is vital that studies recruit experimental and control participants from the same pool.

In sum, there is a sparse but encouraging body of evidence to support exposure to the sensory qualities of fruits and vegetables as a means of encouraging consumption. We hypothesized that encouraging children to engage in sense-based playtime activities with unfamiliar fruit and vegetables would increase their willingness to consume the foods at a later mealtime setting. Exposure activities were similar to those already adopted by nurseries, and included looking at and drawing pictures of a food, feeling its external and internal texture, smelling it, listening to the sound it makes when squashed or snapped, and hearing its name. Given how challenging caregivers find it to encourage young children to taste foods (Carruth et al., 2004), taste exposure was not included in this study. The aim was not to tease apart the individual effects of familiarization with a food in the different sense modalities, but to test the effects of a holistic, sense-based approach to food familiarization with children under the age of 3 years, as it might be applied in a day-care or home setting.

Method

Participants

Twelve nursery classes were selected for the intervention, two from each of six privately-owned day care nurseries in Berkshire. Six classes included 12- to 24-month-old children, while six classes included 24- to 36-month-old children. Three classes from each age group were randomly assigned to form the experimental group; the remaining three classes comprised the control group. A total of 121 children were recruited, of whom 92 completed the test session, 55 in the experimental condition (mean age = 2; 0, range = 1; 1–2; 11) and 37 in the control group (mean age = 2; 0, range = 1; 0–2; 9). The remaining 29 children were absent on the day of testing, largely due to family holidays. Informed consent was provided by the parents of all participants.

Materials

Exposure activities

Each nursery was provided with four activity sheets, each explaining three games specific to one sense: sight, smell, touch or sound (see Appendix for a list of activities). Activities were devised in collaboration with a childcare professional to ensure that they were suitable for toddlers and complemented the national curriculum. Additional resources to support the delivery of the activities included a story and nursery rhyme about each food and a laminated A4 colored photo of each food.

Target foods

Participants were exposed to one of two sets of four foods, two fruits and two vegetables. Set A foods were sweet potato, green pepper, rhubarb and dried figs; Set B foods were butternut squash, broad beans, dried prunes and pomegranates. These foods were selected as likely to be unfamiliar to most children, based on the reports of the nursery staff about the foods served at lunchtime, and on the responses of parents of similarly-aged children to a Fruit and Vegetable Preference and Familiarity Questionnaire in a previous study (Heath, 2013). The two classes at each nursery were randomly allocated to one of the two sets of foods for the exposure phase, to control for the possible greater familiarity of one set of foods at one school. Foods were chosen for their diverse sensory qualities (shape, color, smell and texture) and the two sets of foods were approximately matched for calorie content and colorfulness. Foods were delivered to each nursery once a week by the school's regular supplier.

For the exposure phase, foods were prepared on site (raw or cooked, as required by the activity) by qualified kitchen staff, who were instructed to dice raw foods into 2 cm^3 portions and to prepare cooked foods as if they were to be served as part of a nursery meal. For the test phase, foods were prepared in the same way and were offered raw (green pepper, dried figs, dried prunes, pomegranates) or cooked (sweet potato, rhubarb, butternut squash, broad beans), as appropriate, on the plates usually used at mealtimes. A very small amount of sugar was added when rhubarb was prepared (1 tsp per lb of fruit), in order to make it palatable.