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The effect of preparation method and typicality of colour on children's acceptance for vegetables

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ABSTRACT

This research aimed to investigate if children's acceptance for vegetables was influenced by preparation method or typicality of colour. Sweet potato, cauliflower and beans were tested using different cooking methods and using typically or an atypically coloured vegetable. Children's acceptance was measured among a group of 104 five-and-six year olds. A trained sensory panel determined the vegetable samples sensory characteristics. Background information for children was collected from parents. Preparation method affected acceptance for cauliflower and beans, with baked/stir fried samples accepted less than boiled samples. A high *odour intensity* and the presence of a *browned flavour* were found to lower acceptance. Differences in texture and flavour characteristics imparted by different boiling times, as well as small differences observed in sweetness or bitterness, did not affect acceptance. Atypical colour had a positive influence on expected preference but not on acceptance upon tasting. Familiarity, variety in the number of vegetables liked, and reported liking of target vegetables was associated with higher acceptance. Preparation method was more important for acceptance for children who liked fewer vegetables than those who liked many vegetables.

1. Introduction

The consumption of vegetables has been associated with a lower risk of cardiovascular disease (Dauchet, Amouyel, Hercberg, & Dallongville, 2006) and certain cancers (Key et al., 2004). Vegetables can also play an important role in the prevention of obesity, as increased consumption can reduce energy density, decrease energy intake and promote satiety (Rolls, Ello-Martin, & Carlton Tohill, 2004). Consumption of vegetables below recommended levels is typical in most Western countries (Bowen, Klose, Syrette, & Noakes, 2009; Yngve et al., 2005). The 2007 Australian Children's National Nutrition and Physical Activity Survey found younger children to consume a little over 1 vegetable serve on the survey day (Bowen et al., 2009), whereas two serves are recommended (Anon, 2005).

Many factors are associated with consumption of vegetables below the recommended intakes, including socio-economic status (Baxter & Schroder, 1997; Kirby, Baranowski, Reynolds, Taylor, & Binkley, 1995), mother's education and parental intake of vegetables (Cooke et al., 2004), and availability and accessibility of vegetables (Baranowski et al., 1993; Blanchette & Brug, 2005; Burchett, 2003; Neumark-Sztainer, Wall, Perry, & Story, 2003), but sensory preferences were a key barrier to consumption (Baranowski et al., 1993; Baxter & Schroder, 1997; Blanchette & Brug, 2005; Burchett, 2003; Neumark-Sztainer et al., 2003). Several studies were successful in increasing children's sensory acceptance and consumption of a vegetable with exposure to the vegetable using daily tastings for 2 weeks (Wardle et al., 2003; Wardle, Herrera, Cooke, & Gibson, 2003).

Children are born with a preference for sweet and a dislike for bitter foods (Steiner, 1979). However, most food preferences are learned and childhood appears to be one of the critical phases in the development of such preferences (Köster & Mojet, 2006). Physiological factors related to development of oral musculature and dentition are thought to be dominant in shaping attitudes to texture (Szczesniak, 1972), and texture appears to be of particular relevance for children's food acceptance (Baxter, Jack, & Schröder, 1998; Baxter, Schröder, & Bower, 2000; Szczesniak, 1972, 2002; Zeinstra, Koelen, Kok, & de Graaf, 2007). Based on interviews with mothers of four or more children, children of up to 12 years old were found to dislike textures that are difficult to manipulate in the mouth and to like simple, one-dimensional textures more than textural contrast (Szczesniak, 1972). Six-to-12 year old children's disliked slippery or slimy foods, whereas crispiness became a liked texture for children of this age group (Szczesniak, 1972). These findings are supported by Baxter et al., who found that hard and crunchy vegetables were preferred by 8–10 year olds using repertory grid with vegetable photographs (Baxter et al., 1998). However, the same research group found children to prefer soft, juicy

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and flavoursome vegetables in another study using the same methodology and age group, but a different set of vegetables (Baxter, Schroder, & Bower, 1999). These findings demonstrate that it is difficult to determine the contribution of flavour and texture properties to vegetable acceptance by using between-vegetable comparisons and without actual tasting.

Within vegetables, sensory properties can be modified by preparation and several studies suggested preparation method may influence children's acceptance (Baranowski et al., 1993; Baxter & Schroder, 1997; Baxter et al., 1998; Kirby et al., 1995; Reinaerts, De Nooijer, Van de Kar, & De Vries, 2005; Szczesniak, 1972). Baxter et al. (1998) and Szczesniak (1972) found that children preferred raw vegetables to cooked vegetables. Baranowski et al. (1993) observed that children preferred vegetables served raw with a dip, or cooked with butter or a cheese sauce. Baxter et al. (1998) observed that certain vegetable preparations were particularly associated with dislike of textural properties. However, none of the above mentioned studies involved actual tasting, and instead were based on interviews or questionnaires only.

Few studies have investigated the effect of preparation on within-vegetable acceptance by actual tasting. Blossfeld, Collins, Kiely, and Delahunty (2007) presented 12 month old infants with steamed carrots prepared in two ways, chopped and pureed, and found the highest intake and reported enjoyment for pureed carrots. Using apples of three different textures, pureed, lumpy and diced, infants (average age 10 months) were found to respond negatively to complex textures whereas toddlers (average age 17 months) showed more positive head and body movements and more eagerness for complex textures than the infants did (Lundy et al., 1998). Both studies suggested that experience with difficult-to-chew textures could facilitate a preference for a more complex texture. As far as we are aware, only one study investigated the effect of preparation method on sensory vegetable preferences of older aged children by tasting (Zeinstra, Koelen, Kok, & de Graaf, 2010). These authors investigated preference for carrots and beans each prepared in six ways among children ranging from 4 to 12 years, and among young adults. All age groups were found to prefer boiled and steamed vegetables to those that were stir fried, mashed, fried and grilled. Vegetable liking was positively related to uniform surface appearance and typical vegetable taste, moderately to crunchiness and negatively to brown colouring and granular texture.

The role of appearance for children's acceptance of vegetables has received little attention. Baxter et al. (2000) found size and colour to affect children's acceptance for vegetables. Small, brightly coloured vegetables were preferred to large, dark green (and leafy) varieties. Zeinstra et al. (2007) found appearance and texture to be the most important determinants for liking and disliking in fruit and vegetables in 4–5 year-olds, whereas a shift towards taste attributes was observed in 11–12-year-olds. The youngest age group categorised fruit and vegetables on the basis of colour and shape; items of the same colour were put in the same group. These studies indicate that colour is important for children's acceptance of vegetables, although results were based on between-vegetable comparisons only and cannot be extrapolated to within-vegetable comparisons. The importance of colour for young children's evaluations was further demonstrated in a study in which drinks with atypical colour/flavour pairings (e.g. a brown drink with orange flavour) were presented. Children of 7 years and below relied on the colour of the drink to make a decision about its taste, whereas identifications of subjects of 10 years and older were predominantly flavour-based (Oram et al., 1995).

Expectation theories (for an overview see Schifferstein, Kole, and Mojet (1999)) predict that expectations influence subsequent liking. Children who do not like a particular vegetable can be assumed to have low expectations about its taste once they identify it due to previous appearance/flavour associations; the opposite may be the case for children who like that vegetable. In fact, colour has been suggested to affect children's vegetable preferences as a result of previously established colour-flavour associations (Baxter & Schroder, 1997). Most vegetables are commercially available and consumed in one colour (e.g. green beans), although other coloured varieties may exist. Atypically coloured vegetables, such as yellow French beans, due to low availability and thereby low familiarity, may be less associated as belonging to the same vegetable category and may not evoke the same expectations as their typically coloured counterpart. Rather, their evaluation may be less influenced by (prior) expectations. To our knowledge, no studies have been published that examined the role of colour or colour typicality on children's acceptance within the same vegetable type.

This study investigated the effect of cooking preparation and typicality of colour on children's acceptance for vegetables by actual tasting using a within-vegetable, within-subject design. No prior assumptions were made about the relative importance of colour congruency, flavour and texture for acceptance, but a firm, crunchy texture and an atypical colour were hypothesized to positively influence acceptance. Acceptance was related to background characteristics of the children and to objective information on sensory properties of the vegetables. The main focus of this study was on different cooking methods using typically coloured vegetables, as these comprise the large majority of vegetables consumed. Five and six year olds were selected for this study. Food neophobia reaches a peak between three and 6 years (Köster & Mojet, 2006; Pelchat & Pliner, 1995), and children of the selected age group have the cognitive ability to rate acceptance reliably (Guinard, 2000). The objectives of the study were fourfold: (1) to determine children's acceptance for typically coloured vegetables prepared for eating in three different ways; (2) to determine children's acceptance for typically and atypically coloured vegetables prepared in the same way; (3) to determine relationships between preparation methods, sensory attributes and children's acceptance, and (4) to determine if behavioural and socio-demographic factors impact on acceptance.

2. Materials and methods

2.1. Participants

Children, and one of their parents, from the Sydney metropolitan area, Australia, were recruited by a recruitment agency. Children were aged 5 or 6 years and had to attend primary school. Children who strongly disliked two or more of the target vegetables (i.e. sweet potato, cauliflower and French beans), as well as children, or children of parents, with any known food allergies or dietary intolerances were excluded. A total of 104 children participated in the study. All child/parent pairs were paid for their participation. Ethics approval for the study was granted by the CSIRO Human Research Ethics Committee.

2.2. Samples

Three vegetables, sweet potato (*Ipomoea batatas*), cauliflower (*Brassica oleracea botrytis*) and French beans (*Phaseolus vulgaris*), were selected as examples of various vegetable categories. Vegetables were chosen that were substantially different in sensory properties, had economic importance in terms of market value in Australia and were not highly liked nor highly disliked by children in a pilot test. The pilot test ($n = 18$) used the same recruitment criteria and methodologies as the actual consumer test. An additional vegetable, eggplant, was tested, but was disliked and was not selected for further testing.