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Adolescent and adult visual preferences for pictures of fruit and vegetable mixes – Effect of complexity

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ABSTRACT

Complexity is an important parameter for the appreciation of foods as a bell-shaped relationship between hedonic appreciation and complexity has been found by Berlyne (1970). The aim of this study was to examine the relationship between adolescent and adult visual preferences and perceived complexity for vegetable (V), fruit (F), and combined fruit and vegetable (FV) mixes. Two hundred and forty-two adolescents and 119 adults performed three incomplete rankings of visual preference of eight pictures of V mixes, eight pictures of F mixes, and eight pictures of FV mixes, respectively. The three sets of pictures varied in their level of collative properties. They were designed using a 2^3 design by varying the cut, color, number of products, type of product, and combination of products. The pictures were also evaluated for perceived complexity by a descriptive panel. The results show high correlations between designed collative properties and perceived complexity. Inverted U-shaped relationships between visual preference and perceived complexity were found for both the V mixes and the F mixes but not for the FV mixes. For the V and the F mixes, the subjects' optimal level of complexity was found dependent on whether they were adolescents or adults, frequency of eating fruits and vegetables, and gender.

1. Introduction

Many factors in addition to the flavor of a food contribute to its liking (Zellner, 2007). The visual appearance is usually the first sensory stimuli that is presented to a consumer and which influence the expectations towards the food. The visual properties may produce positive sensations leading to acceptance of a food, or negative sensations leading to rejection. Hence, visual cues and appearance are essential regarding acceptance or rejection of food (Cardello, 1996; Hurling & Shepherd, 2003). Appearance properties comprise visual properties, including color, physical form and shape, and mode of presentation (Hurling & Shepherd, 2003).

Actions based on theories within psychology of aesthetics might be applied to make food products more visually appealing and thereby positively affect food choice. According to Berlyne's collative motivation model, based on visual illustrations, there is a bell shaped relationship between hedonic appreciation and arousal potential (Berlyne, 1970). Collative properties such as complexity, novelty, surprisingness, and variability contribute most to the arousal potential (Berlyne, 1966). Visual patterns with low arousal potential and thus low levels of perceived collative properties are not stimulating and leave the observer indifferent; patterns with very high arousal potential and thus high levels of perceived collative properties are too difficult to grasp and are considered unpleasant. Preferred are patterns with an arousal potential at a medium (or optimum) level, leading to the inverted U-shaped function between hedonic appreciation and arousal potential. Another important factor is familiarity for a stimuli. Familiarity and repetition makes perceptual and cognitive processing easier, as it increases its perceptual fluency. The more fluent perceivers can process a stimuli, the more positive their aesthetic response will be. Zajonc provided a systematic empirical study of this phenomenon, reporting evidence that mere exposure to a stimuli increases its aesthetic appreciation (Zajonc, 1968).

The study of a products complexity's effect on subjects' perception have been extended to other than visual artistic stimuli including perception of aroma and perfumes (Jellinek & Köster, 1979, 1983; Sulmont, Issanchou, & Köster, 2002) and the overall perception of food products with special focus on mere exposure (Levy, MacRae, & Koster, 2006; Reverdy, Schlich, Köster, Ginon, & Lange, 2010; Sulmont-Rosse, Chabanet, Issanchou, & Köster, 2008). Only few studies have looked on the effect of complexity based on the appearance of food (Kildegaard, Olsen, Gabrielsen, Møller, & Thybo 2011; Zellner, Lankford, Ambrose, & Locher, 2010). However, to study the complexity of visual presentations of foods alone is not without challenges as our perception of the appearance of food is affected by both the appearance as well as

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the expectations of the overall sensory quality of the food we generate when looking at the food (Cardello, 1996). This is contrary to drawings which as such do not have a practical purpose such as to be consumed. Nevertheless, if we want to use the principles of the collative motivation model of Berlyne in product development, we need to test the effect of changes in collative properties such as complexity on preference in real food systems. This also includes complexity based on appearance, especially due its importance in food choice.

Fresh fruit and vegetables are characterized by their varied appearance and bright colors. The shape, size, gloss, and vibrant color of fresh fruit and vegetables attract us and entice us into picking it up by fork or hand (Barret, Beaulieu, & Shewfelt, 2010). To study the effect of complexity based on the appearance of real food systems, these particular food categories thus seem highly relevant as visually very different mixes can be created. In addition, Danes in general eat too little fruits and especially vegetables (Pedersen et al., 2010) and finding the right visual combination of mixes might be a mean to increase their intake of fruit and vegetables.

Taking the existing literature into consideration, it is hypothesized that for fruit and vegetable mixes there is an optimal level of complexity with regards to their visual appearance. Due to the effect of pacers and mere exposure on the appreciation of more complex stimuli (Dember & Earl, 1957; Zajonc, 1968), it is further hypothesized that younger subjects will prefer less complex mixes compared to adults since they have been less exposed to these food products. On the same vein, it is further hypothesized that fruit and vegetable consumption frequency will have a positive effect on the optimal complexity level. Additionally, differences in appreciation of the mixes depending on gender are hypothesized due to reports on gender differences in the preference of more or less complex aromas and perfumes (Jellinek & Köster, 1979, 1983). How hungry the subjects are is also thought to affect the optimal complexity as is has been found to affect visual preference for yoghurts and smoothies in children (Kildegaard, Olsen, Gabrielsen, Møller, & Thybo 2011).

These hypotheses are elucidated by the following aims.

- to investigate the relationship between designed collative properties and complexity perceived by a descriptive panel for visual stimuli of V, F, and FV mixes.
- to test if there is an inversely U-shaped relationship between perceived complexity and subjects visual preferences of V, F, and FV mixes.
- to further explore if age, gender, hunger state, and frequency of eating fruits and vegetables affect the relationship between perceived complexity and subjects' visual preferences for V, F, and FV mixes.

2. Methods

2.1. Stimuli

A total of 24 pictures of fruit and vegetable mixes designed to a priori vary in their level of collative properties were used in this study. The mixes were developed based on the authors' own perception of degree of collative properties and the findings from the pilot study (Fig. 1).

The following parameters were considered important (listed from low to high degree of collative properties): The cut of the products in the mix, the amount of different colors and the contrast between the colors of the products in the mix, the amount of different products in the mix, the product types, and finally the combination of fruit and vegetables in the mix. Prior to this study, a pilot study was conducted where the role of portion size, skin color, and cuttings' effect on adolescent visual preference for apples was studied. Significant differences in visual preferences for both portion size (small or large), color (red or red and green), and cut of apples (halves or squared) were found. In general, cut squared apples were preferred whereas mixed results were obtained for the color of apples. Based on these results, we found it relevant to look into the above-mentioned factors.

The 24 pictures used in the current study were made up of three sets of eight pictures of mixes: Eight fruit (F), eight vegetable (V), and eight combined fruit and vegetable (FV) mixes (Fig. 2a–c). For each set of pictures, an underlying 2^3 design was used.

The eight V mixes consisted of bell peppers in different colors (yellow, orange, and red) and cuts (sticks 0.5 × 8 cm versus cubes **0.5** × **2** cm). Bell peppers were chosen as they come in different bright colors.

The eight F mixes consisted of different colored grapes (green and dark blue grapes), presence or absence of blueberries and apples in different cuts (1.5 cm × 5 cm long slices versus 1.5 cm × 2 cm cubes). Apples and grapes were chosen as they are familiar and popular fruits in Denmark. Blueberries were chosen as these are a fairly new and unfamiliar commercial product on the Danish market (Bisgaard, 2009).

The eight FV mixes consisted of both fruits and vegetable products. This set of pictures was hypothesized to possess the highest level of collative properties as it is uncommon to mix fruits and vegetables together in Denmark. Nevertheless, it was found interesting to see whether the popular fruits could increase the popularity of the less popular vegetables in a mix. In the FV mixes, bell peppers, either yellow or as a mix of yellow, orange, and red were used as a base. Blueberries and grapes were chosen for the same reason as stated above whereas carrots were chosen as it is commonly consumed as a raw snack in Denmark. All pictures including names and the used design factors are shown in Fig. 2a–c. The 24 mixes were expected to vary in collative properties such as complexity and familiarity, however, since only perceived complexity was measured, this is the focus of this paper.

All 24 mixes weighed 175 g which was equally distributed between the numbers of products in the mix, i.e. if a mix contained four products, each product weighed 44 g. The mixes were placed in 15 cm petri dishes without lids and photographed just after preparation.

2.1.1. Pictures

Pictures were taken of each mix with a Canon EOS 20D camera. The photos were taken at an aperture value of F20, at ISO 100, with a shutter speed of 1/200 s, a focal length of 100 mm, and a resolution of 300 × 300 dpi in the sRGB color space. The photos were

Low Level → High Level				High Level
	Cut	Few bigger pieces	→	More smaller pieces
	Color	One color	→	More colors (and then color contrast)
	Products	Few products	→	More products
	Product types	Common products (in DK)	→	Less common products (in DK)
	Combinations	Only fruit or vegetables	→	Fruit and vegetables together

Fig. 1. Designed collative property chart, going from lower to higher level both vertically and horizontally. The chart is based on the authors' own perception of collative properties.