If I can taste it, I want it...
Sensory Marketing in Grocery Retail Stores
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Abstract

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This thesis is based on four studies taking a quantitative and qualitative approach, and combining three different research areas: sensory science, linguistics, and marketing science. Each study stands alone as a piece of research, but the overall aim was to investigate the creations of a sensory marketing strategy, with a focus on food and taste, for using a sensory language as a marketing tool in grocery retail stores.

The sensory study aimed to examine sensory descriptions and compare consumer perceptions with those of a trained sensory panel. The perceptions expressed by the consumers correlated quite well with the terminology used by the trained panel, and a partial least squares regression showed that the two groups used many identical words. Taking a qualitative approach, a sensory semantic frame was constructed on the basis of the vocabulary used by the two groups. The combination of sensory and semantic analysis could be one way of extracting valuable words for use in contexts such as product description for marketing purposes in retail stores.

The sensory description labels were then used in different observational studies in grocery retail stores to investigate consumer choice behaviour in response to different sensory marketing cues such as sensory description labels, taste preference, price, and visual appearance. The sensory description labels were found to have an effect on consumer choice behaviour. For example, when only the brand name was given on the label, the consumers tended to choose the apples with a strong brand name, but their choice shifted when sensory description labels were added. Consumers also tended to be less price sensitive when sensory description labels were present.

Keywords: advertising, brand/product choice, consumer behaviour, decision-making, food choice, labelling, sensory description, sensory marketing, sensory perception, semantic frame theory, retailing

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List of papers

This thesis is based on the following papers.


Sammanfattning

Avhandlingen syftar till att undersöka hur man kan utveckla ett kognitivt baserat sensoriskt språk för olika produkter i detaljhandel och därefter använda det i marknadsföringen i butiksledet. Vidare undersöks om denna marknadsföring har någon effekt på konsumenternas val av produkt. Inom forskningsprocessen, tvärvetenskapligprocess, används metodik och teorier inom sensorik, lingvistisk (semanstik) och marknadsföring (konsumentbeteende).

I en sensorisk studie jämfördes en tränad sensorisk panel och en grupp konsumenters förmåga att beskriva och analysera olika produkters sensoriska egenskaper. Resultatet visade på att de två gruppernas beskrivningar av de olika produkterna var relativt överensstämmande. Att beskriva smak verbalt anses som relativt svårt och komplex. Baserat på det sensoriska resultatet analyserades egenskapsorden ytterligare utifrån ett lingvistiskt semantiskt perspektiv. Den semantiska analysen, empiriska resultat och teori, påvisade en möjlighet att utvinna värdefulla attribut från mer diffusa attribut, t.ex. ”nötig smak” – som kan härledas från sort, e.g. ”mandel” som i sin tur innefattar olika egenskaper i form av smak, doft, textur etc.

För att ta reda på om de sensoriska beskrivningarna hade någon effekt på konsumenternas beteende och val i butik genomfördes två empiriska studier. Konsumenternas val av produkt i butik studerades utifrån olika variabler; sensoriska beskrivningar, sensoriska och semantiska beskrivningar, sortnamn, pris, och smak preferens. Resultatet visade att de sensoriska beskrivningarna påverkade konsumenternas val av produkt, t.ex. när bara sort namn kommunikerades var man benägen att välja en känt sort, men när man använde sig av sensoriska beskrivningar skiftade konsumenternas val och de var inte längre stydda av det mer välkända sortnamnet.

Vidare visade det sig att konsumenterna var mindre priskänsliga när sensoriska beskrivningar visades. Konklusion: Användningen av ett sensoriskt språk i marknadsföringen av de undersökta livsmedlen påverkade konsumenternas val av produkt i butik samt att konsumenterna tenderade att vara mindre priskänsliga när sensoriska beskrivningar användes.

Nyckelord: detaljhandel, konsumentbeteende, marknadsföring, produktval, reklam, semantik, sensorik, sensoriska beskrivningar, sinnesmarknadsföring.
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Introduction

Food marketers need competitive marketing tools to differentiate their product on the market and to increase consumer preference for their products. One possible way of achieving this is to make the purchase and consumption experience of the food product more exciting. There are numerous attempts on the market, using the power of names, slogans, and different descriptions in order to attract consumers to choose a particular product. It is quite common for food marketers to use irrelevant attributes which are not related to the product’s performance or sensory quality, such as “tasty”, “good”, “fresh”, or “well-balanced”, or to describe their products as “premium” or “selection” (Clow and Baack, 2010). However, a valid question is what does this actually mean? What do consumers pay for in terms of eating quality, perceived taste? Why not apply a more objective sensory description, which actually describes the attributes of foods that are relevant to taste? By doing this, it might be possible inspire consumers to other food choices; in addition, consumers might be willing to pay a higher price when quality is communicated. However, in the end, this approach may also be able to increase the consumers’ loyalty and satisfaction, by telling them what to expect when they consume the product.

This thesis sets out to combine different methods and theories from sensory science, linguistic science, and marketing science, with the aim of contributing some valuable insights into how to create and use a sensory language as a marketing tool for food products in a grocery retail store. Sensory language in general has long been used by chefs and restaurants when selling wines and describing food, both orally and on the menu (Herdenstam et al., 2009). What the present thesis sets out to do is to highlight the process of how we as human beings express sensory stimuli in words, and to explore how this expression could be further developed within linguistics and in marketing. This is in line with the field of sensory marketing, which is defined by Krishna (2010) as “marketing that engages the consumers’ senses and affects their behaviour”, and to do so, it is suggested that we create new sensation or merely emphasizing or drawing attention to existing sensations can increase a product’s appeal (Krishna, 2010).

The basis for the present thesis is the interplay within the creative world of culinary arts and meal science (CAMS). CAMS allows us to combine the research disciplines of sensory science, linguistic science, and marketing
science. Within this multidisciplinary field, a conceptual model known as the Five Aspect Meal Model (FAMM) was developed to structure the process of the kind of experience mentioned above. The aspects of the model are 1) the room, 2) the meeting, 3) the product, 4) the control management system, and 5) the atmosphere. The different aspects and how they affect the consumers are well described by Gustafsson (2004) and Gustafsson et al. (2009, 2006). Previous research within CAMS has highlighted the different aspects of this model with different perspectives (Walter, 2011, Rapp, 2008, Prim, 2007, Tellström, 2006, Hansen, 2005, Jonsson, 2004, Nygren, 2004).

Additionally, within the FAMM model which concerns the food and drinks we consume, it is essential to measure how we as human beings perceive different stimuli and how we describe these stimuli in words. There are a number of different methods within sensory science which can be used for these measurements. Sensory science is defined as a “multidisciplinary field comprising measurement, interpretation and understanding of human responses to product properties as perceived by the senses such as sight, smell, taste, touch and hearing” (Lawless and Heymann, 1999). There have been a few research projects within the discipline of CAMS concerning this type of question; for example, wine and cheese in combination (Nygren, 2004), and butter flavour in culinary sauces (Rapp, 2008). Describing the sensory characteristics of a product or a meal may not be entirely straightforward (Murray et al., 2001). For example, we would usually describe a taste experience as “good” or “bad” (Civille and Lawless, 1986); this type of difficulties are often referred to as “tip of the nose” phenomena (Lawless and Engen, 1977). Within sensory evaluation and descriptive analysis (DA), the important thing is the objective description of a product in terms of perceived sensory attributes, and the ability to describe this experience verbally plays a vital part (Civille and Lawless, 1986). One necessary task in the present thesis was to establish the relationship between the ability of consumers and the ability of a trained sensory panel to describe a sensory stimulus in words (paper I).

However, even when, for example, both the trained sensory panel and the consumers describe a given sensory stimulus such as “nutty”, it is vital to extract more information. One way of doing this is to elicit more descriptive words derived from other subcategories in order to describe the stimulus more thoroughly. Given the central role of the lexicon in describ-
ing the sensory qualities of food, surprisingly little attention has been paid to theories of linguistic science and sensory science; this may be due to the fact that sensory studies and linguistics belong to different academic disciplines. Paper II describes a potentially suitable approach, being a cross-disciplinary meeting between sensory science and linguistic science, semantic frame theory. A semantic frame could be defined as a description and representation of how the mental lexicon is structured and organised in long-term memory and working memory, and how different sensations and experiences of the outer world are linked to words. In this theory, words, or rather concepts and conceptualisations beyond the word, are represented in the mental lexicon as a kind of network consisting of a root or trigger concept which is framed or surrounded by other concepts (Barsalou et al., 1993, Barsalou, 1992, Fillmore and Atkins, 1992). For example, the word “nutty” could be derived from different subcategories such as the specific type of nut that is being considered (e.g. “almond”); this then gives rise to additional attributes derived from the concept of “almond” which would make it possible to expand the sensory description for the product in question.

Another perspective to consider when trying to market the sensory characteristics of food products is how consumer choice behaviour is affected by different sensory descriptions in grocery retail stores. Recently, there has been an increased focus on sensory description labels for food and wine in relation to consumer choice behaviour. For example, Lockshin et al. (2009) demonstrated that the presence of taste descriptions for wine increased the choice within the category. Also, Wansink et al. (2005, 2001) found that using sensory descriptive names on menus in a restaurant, for example using “succulent Italian seafood filet” rather than simply “seafood filet”, affected the consumers’ choice, increased sales, and resulted in a more positive consumer attitude. However, to the knowledge of the present author, there have as yet been no studies in which a sensory language was developed on the basis of a sensory analysis and then analysed with a semantic frame theory perspective. The present thesis used an observational approach to investigate how different sensory description labels may affect consumer choice behaviour in a grocery retail store (paper III).

Paper IV addresses some of the limitations of paper III, adding a number of other variables such as price and visual appearance. The use of a sensory language and ways of communicating may vary between different catego-
ries of product and different marketing levels, as well as in relation to other variables; for example, consumers may be willing to pay a higher price for food products with a sensory descriptive label. It is also worth asking whether taste preference is congruent with the sensory descriptive label or with the visual appearance. It has been demonstrated that consumers may find it quite difficult to choose their favourite product when labels, brand cues, or visual appearance are absent or ambiguous (Hoegg and Alba, 2007b, McClure et al., 2004, Calvo et al., 2001, Allison and Uhl, 1986). Paper IV again uses an observational approach, in this case to reveal how consumer choice behaviour in a grocery retail store is affected by sensory description labels, price, visual appearance, and taste preference.

**Purpose of thesis**
The overall purpose of the present thesis was to create a sensory language for food products and to investigate how this type of language can affect consumer choice behaviour in a grocery retail store. The thesis has four specific aims:

**I:** To examine the sensory description of a group of apples and compare consumer perceptions with those of a trained sensory panel.

**II:** To analyse the sensory vocabulary further by using a semantic frame model, to develop a sensory semantic language model to expand the sensory vocabulary, and to create sensory language models for use in marketing.

**III:** To investigate the effect of sensory description labels on consumer choice of apples in a grocery retail store.

**IV:** To investigate consumer choice behaviour in a grocery retail store, and how this is or is not affected by the introduction of different sensory marketing cues such as sensory description labels, taste preference, price, and visual appearance.
What this thesis contains
This thesis is based on four different papers, each of which treats the aims step by step (see Table 1).

Table 1. Overview of the papers within the thesis; aim, method and material, and data analysis.

<table>
<thead>
<tr>
<th>Aim</th>
<th>Paper I</th>
<th>Paper II</th>
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<tr>
<td>To examine the sensory description of a group of apples and compare consumer perceptions with those of a trained sensory panel.</td>
<td>To analyse the sensory vocabulary using a semantic frame model, to develop a sensory semantic language model to expand the sensory vocabulary, and to create sensory language models for use in marketing.</td>
<td>To investigate the effect of sensory description labels on consumer choice of apples in a grocery retail store.</td>
<td>To investigate consumer choice behaviour of tomatoes in a grocery retail store, and how this is or is not affected by the introduction of different sensory marketing cues.</td>
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<td>Sensory analysis: descriptive analysis with a trained panel (n=12) and repertory grid method with consumers in a grocery retail stores (n=34) Eight apple varieties.</td>
<td>Semantic frame theory. Qualitative analysis based on quantitative data. Nine baby leaf salads.</td>
<td>Observational study in a grocery retail store. n=1623, four sessions, independent data. Three apple varieties.</td>
<td>Observational study in a grocery retail store. n=1163, three sessions, dependent data within session. Three tomato varieties.</td>
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<td>Analysis of variance (ANOVA). Multivariate analyses using PCA and partial least squares regression to study the relationship between the two groups.</td>
<td>Words from the sensory analysis in paper I were grouped into different semantic domains, frames of concept for different attributes.</td>
<td>Frequency distribution of preferred apple in each session. Fitting nominal regression model to analyze the probability of choosing an apple. T-test with significance set at p&lt;.05.</td>
<td>Frequency distribution of preferred tomato in each session. Pattern of change in choices as paired data sets in contingency table. T-test with significance set at p&lt;.05.</td>
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Theoretical framework

Sensory science
According to Whorf (1956), language reflects and determines the way we perceive the world. Humans do not all perceive the world in the same way; each of us views a world that has been organised by the linguistic system that we use. For example, according to Whorf, Eskimos use more complex language to describe snow, because snow is more important to them than it is to other people. To describe the world according to vision and to a certain extent audition are characterised by strong and inborn mechanisms so we perceive the same forms and estimate distances and directions in similar way. However, we perceive taste and flavour with the lower senses in the oro-nasal cavity, and not with the same strong inborn mechanisms as for vision and hearing; instead, we rely more on learning and experience. Hence, we actually have to perform a conscious act to learn and practice ways of expressing a product’s sensory characteristics in relation to taste (Köster, 2003). In reality, most of us are unlikely to talk about the sensory experience of the food we eat, unless we happen to be gastronomes. When we eat food, we perceive a blend of taste, smell, and haptic inputs; flavour is a combination of smell and taste (Rozin and Hormes, 2010).

Sensory lexicons have been discussed by Civille and Lawless (1986) and by Lawless and Heymann (1999), and different sensory lexicons for flavour are widely used to describe and compare products within a category (Drake and Civille, 2003). Lexicons and studies on vocabulary development have been published for a large number of products in recent years, covering the flavour, taste, odour, and texture of items such as fresh leaf vegetables (Talavera-Bianchi et al., 2010a), French bread (Hayakawa et al., 2010), almonds (Civille et al., 2010), cod (Sveinsdottir et al., 2010), cheese (Talavera-Bianchi et al., 2010b, Yates and Drake, 2007, Retiveau et al., 2005), brewed coffee (Seo et al., 2009), chocolate (Thamke et al., 2009), tomatoes (Hongsongnern and Chambers, 2008), yoghurt (Coggins et al., 2008), green tea (Lee and Chambers Delores, 2007), rose apples and Asian fruits (Vara-ubol et al., 2006), pawpaw fruit (Duffrin and Pomper, 2006), 2006), and honey (Galan-Soldevilla et al., 2005). When communicating a product’s sensory characteristics, whether within academia or in industry, the verbalisation of perceived stimuli is important; this is a concern for many different agents including sensory staff, product developers, engineers, and marketers (Rødabotten, 2009, Meilgaard et al., 2006, Lawless...
and Heymann, 1999, Civille and Lawless, 1986). The present thesis argues that this type of language could also be used advantageously when marketing food products. An example of this is the wine industry, within which this type of language has been used as a successful marketing tool in a number of ways; by sommeliers and professional wine tasters (Herdenstam et al., 2009), on bottles (Mueller et al., 2010b), on shelf information (Mueller et al., 2010a), and on packing labels (Rocchi and Stefani, 2006, Dimara and Skuras, 2005).

**Linguistic science**

As mentioned above, it is not easy to describe one’s perceptions, as this is not a simple transcription of reality but rather the expression of individual sensations in one’s own language. Thus, it is of utmost importance to agree on an intersubjective sensory lexicon for food products when developing a sensory language for use in marketing. To this end, the most valuable technique is lexical semantics within the discipline of linguistic science. A semantic frame could be defined as a description and representation of how the mental lexicon is structured and organised in long-term memory and working memory, and how different sensations and experiences of the outer world are linked to words (Barsalou et al., 1993, Barsalou, 1992). It is only from a semantic point of view that components in and around word meaning such as sense, inherent concepts, semantic domains, specification, style, value, vagueness, and informatively can be mapped in detail (Duffrin and Pomper, 2006, Aitchision, 1994, Noble et al., 1987, Cruse, 1986). A semantically anchored model enables systematicism and lexical precision in the sensory expression. For example, when a person reads the word “apple”, it is likely that other sub-concepts are also actualised, such as appearance (roundness, colour, etc.) and taste (sweetness, sourness, etc.). This depends on the fact that many referential apples are according to appearance, taste etc.

It could be suggested from a semantic perspective that the components in and around word meaning can be mapped in more detail (Aitchison, 1994, Cruse, 1986). One suggestion, as an example, could be (1) sense – what can be said to be the meaning of a certain word; (2) inherent concepts – different concepts are categorised, such as “green” in the word “grass”; (3) semantic domains – words which belong to different superordinates, such as “pineapple” to tropical fruit; and (4) information – words such as
“good” or “bad” lack objective information and are thus difficult to define semantically, unlike “sweet” and “juicy”, where the conceptual content is more obvious. Barsalou et al. (1993) explain the concept through so-called “attributes”. An attribute in this case is a kind of slot which is activated when meeting the word in question; each word includes different varieties of attributes with different values and categories. So when we talk about the product and the word “apple”, categories of attributes are activated, such as vision, touch, odour, taste, and hearing. However, to expand the relationship further, these attributes may include different values; for example, “red” and “green” may derive from the attribute of colour, and “sweet” and “melon” from the taste.

Marketing science
Marketing science is a broad field of research. Within this field, the present thesis focuses on consumer choice behaviour and the decision-making process. As humans, we make numerous decisions every day. Some of these decisions are conscious, but some are unconscious; we do not actually realise that we are involved in a decision-making process. The choices that confront us come in different forms and carry different options, but to make a choice we need the alternatives to be presented (Dijksterhuis et al., 2005, Bettman et al., 1998). Although each step of the decision-making process is important (Engel et al., 1995), this thesis focuses on two of the components which are considered the most important in relation to the purpose of the thesis: information search and evaluation of alternatives. In relation to this, the label information plays an important role in the consumers’ decision-making process. By communicating the product’s sensory characteristics on labels for food products, it may be possible to affect the choice behaviour and the decision-making process of the consumer.

Grocery retail stores and food companies might need to create a competitive advantage to convince the consumers to choose their products or pay a higher price for quality products, premium or selection etc., in order to exceed the additional cost of the differentiation and sale promotion (Barney, 2002, Chandon et al., 2000, Porter, 1985). People working in a grocery retail store may have little or no knowledge about the products they sell, and so a product’s package or label may be the only way to impress consumers and convince them to choose that product. Miller and Kahn (2005) revealed that different ambiguous but trivial attributes can
affect how consumers evaluate a product. However, to date, research concerning food labels and names in grocery retail stores has mainly focused on attributes such as nutritional information, health policy, ingredients, product origin, and safety (Borra, 2006, Wansink et al., 2004, Wansink, 2003, Bureau and Valcheshini, 2003, Baltas, 2001, Teisl et al., 1997, Caswell and Mojdivzka, 1996, Aaron et al., 1995) rather than on the communication of aspects such as the expected eating quality of the product. Additionally, within marketing and advertisement, the focus has primarily been on vision and hearing, with less attention being paid to other senses such as taste (Krishna, 2010, Kennedy, 2008, Peck and Childers, 2008, Lindstrom, 2005, Murphy, 2005, Jacoby et al., 1998). Therefore, it could be further argued that emphasising the product’s sensory qualities would be a possible approach when marketing food products, in this case focusing on taste.

Within the grocery retail store, there are many sensory cues which affect consumers and their behaviour when making a choice of product. We are affected through our five senses in different ways: we visually perceive the store and evaluate the products and packaging design (Becker et al., 2011, Wells et al., 2007), which is often the basis for our decisions on food purchase; we perceive the store and the atmosphere via our sense of smell, for example the aroma of freshly-baked bread (Donovan et al., 1994, Donovan and Rossitter, 1982); we might touch and feel the products to determine which one to choose (Sogn-Grundvåg and Østli, 2009, Peck and Childers, 2006); and if possible we might smell the product (Lindstrom, 2005). However, we are unlikely to be able to determine what the product will taste like within the store, but instead rely on memory and experience and therefore may make a more rational choice of product.

Combining the research disciplines
It is quite a challenge to bring together the different methods and theories from sensory science, linguistic science, and marketing science into the field of sensory marketing research with a focus on taste. The present thesis uses these methods and theories in an attempt to develop a sensory language for use as a marketing tool. Figure 1 sets out to illustrate the degree of the combinations. It is vital to understand the complexity of conducting sensory marketing research, as mentioned in earlier chapters, involving the
senses but also the different disciplines and what they could contribute by interaction.

Aradhna Krishna is the Dwight F Benton Professor of Marketing and one of the authors of the new book, Sensory Marketing: Research on the Sensuality of Products, which could be considered as one of the first cutting-edge research publications concerning the senses and how that brings together the field of sensory marketing (Krishna, 2010). In the introduction of the book, Krishna writes:

“We have hundreds of cereals, shampoos, personal computers, hotels, and airlines to choose from. While marketers have focused on trying to make their products and services more attractive to consumers, I believe that sensory aspects of products and services have not been emphasized enough.”

These words inspired the framework for the present thesis on sensory marketing in a grocery retail store. The thesis aims to contribute some valuable insight to the field of sensory marketing. I believe that overall, marketing has focused on the visual aspect of the products such as packaging, advertisements, special offers, and so on, and to some extent has ignored the other senses, such as taste and odour. The interplay in how we perceive a food product according to our taste experience may provide a valuable contribution towards engaging consumers on a new level. When marketing food products in a grocery retail store, it is helpful to be able to understand how our products are perceived by the consumers. This thesis focuses on food products, and on the taste of these products, and so uses sensory science as a platform to investigate the relational links between product and person, and the interdisciplinary links between sensory science, linguistic science, and marketing science. The aim is not to come up with a new research discipline, but rather to shed some light on the field of sensory marketing, to make a contribution to the field, and to provide some new ideas for how to take advantage of these disciplines and their methods and theories in order to enhance the marketing communication of food products in a grocery retail store.

The first step in the present thesis was to investigate how consumers perceived the specified product and how they would describe the product in words (paper I). Although lexicons and different vocabularies have al-
ready been developed within sensory science, they are not commonly used in marketing. Instead, they are mainly used for internal communication within laboratories or company departments during the development of the product, for quality control, and so on. The present thesis sets out to demonstrate the value of this type of language in a marketing context, to discuss some ways of using and developing it further as a complement to factors such as packaging and advertising, and to assess how it can make the product more sensorially engaging to the consumer. Collaboration between sensory researchers and marketers could be of great benefit for both parties, allowing them to exchange knowledge and experiences. For example, sensory scientists could predict how the consumers will perceive the product via their senses, and the marketers know how to market the product most efficiently.

Previous research within the discipline of sensory science is generally lacking in terms of how to further develop the language from a linguistic point of view. Paper II focuses on the language theories concerning the spoken (or unspoken) expression of our sense impressions; this might reveal a possible approach to developing and increasing knowledge about the importance of linguistics when dealing with sensory science and marketing science. From a sensory point of view, the linguistic semantics theory of semantic frames may be a suitable tool to use within the procedure of lexicon development for food products, to find the proper words to describe a sensation. The interaction between these two disciplines, sensory and linguistic science, seems to be a relatively new type of cross-disciplinary meeting. This type of interaction is also relevant within the discipline from a marketing aspect, for example in extending and developing the language used to market the products. As mentioned in the previous chapter, only a few research studies have used sensory description labels. For example Wansink et al. (2005, 2001) created their sensory description labels by brainstorming within the research group without any support from a sensory perspective. This might also be the method commonly used by companies, marketers, advertisers, and copywriters when creating sensory description labels, which could be why such description ends up telling the consumers that the product is “good” and “tasty”, or simply using trivial attributes. It could be argued that the use of subjective descriptions is quite risky; who says that the product is “good”, the company or the consumers? If the consumers would in fact describe a product as “good” or “tasty”, the company or marketer should ask themselves which are the
unique selling points for the word “tasty” in relation to this product, and how these attributes could be used in marketing to engage the consumer's senses and differentiate this product from other products. However, the consumers may rely on and trust the product information communicated by the manufacturer (Hoegg and Alba, 2007a). The labels or description should communicate relevant information so the consumers could relate to it and that the descriptions if framing the product (Hoegg and Alba, 2007a). This type of contexture is vital when trying to create a sensory language for use in marketing. However, to my knowledge there have as yet been no studies that have tried to combine these disciplines with the goal of creating a sensory marketing approach for a food product by using sensory descriptions in grocery retail stores.

Figure 1. Combination of the research disciplines and their methods and theories: sensory science, linguistic science, and marketing science, within the field of sensory marketing.
Methods and materials
Several different methods were used to collect the data and to achieve the different aims (see Table 1). All products were chosen from the fruit and vegetable category: apples, baby leaf salads, and tomatoes. This chapter describes and discusses the methods and materials.

Sensory analysis
In this first step (paper I), two different sensory methods were used to compare the perceptions of a trained sensory panel with those of consumers; descriptive analysis (DA) for the panel and the repertory grid method (RGM) for the consumers. The procedure followed the approach of Hersleth et al. (2005).

The main argument for using descriptive analysis and a trained sensory panel is that such a panel may be able to characterise and describe products more accurately than untrained consumers (Lawless and Heymann, 1999, Murray et al., 2001). It is therefore essential to establish that a trained sensory panel perceives and uses similar attributes to the untrained consumers. It is often assumed that consumers are less sensitive and less able to describe their perceptions than a trained sensory panel, and consumer tests are most often used to measure acceptance and preference (Lawless and Heymann, 1999). Previous research has investigated the relationship between the perceptions and vocabulary use of a trained sensory panel and those of consumers, covering different products such as perfume (Worch et al., 2010), brewed coffee (Seo et al., 2009), ice cream (Ishii et al., 2007), bread (Hersleth et al., 2005), and fruit and vegetables (Fillion and Kilcast, 2001), showing that the perceptions of the two groups were quite similar.

DA tests are considered to be the most sophisticated instrument in the arsenal of sensory methods, and are an efficient tool when it comes to describing the qualitative aspects of a food product (Lawless and Heymann, 1999). However, the outcome of using a trained sensory panel depends on a number of different factors; for example, the ability of the panel leader to train and calibrate the panel is important for a valid result. The method could be considered quite time-consuming when using a new and inexperienced panel which may require an extended period of training. However, this would not be the case for an already established and trained panel, which should be able to conduct the sensory analysis relatively quickly.
without spending much time on training. However, the procedure and methods used by the panel leader may differ and could be considered as a crucial part of the training (Rødbotten, 2009, Meilgaard et al., 2006, Lawless and Heymann, 1999, Piggott and Hunter, 1999, ISO, 1993). The panel leader in the present thesis had some previous experience in training the panel through different research projects, and was also a highly experienced chef with a great deal of experience working with food and taste, and communicating sensory characteristics in general. The process does also require some general skills in capturing the interest of the panellists and motivating them to attend all the training sessions; in this case, the training period lasted three weeks for a total of 25 hours divided into 12 sessions. The panel consisted of students at the university campus who were recruited, then selected as panel members according to their sensory abilities (ISO, 1993). All panel members were generally interested in meal science and gastronomy, and had taken a basic course in sensory science. Ways to express sensory characteristics also played an important role in their education programs and professions as chefs, restaurant managers, product developers, sommeliers, and so on.

Consumers were recruited in two different grocery retail stores in Sweden when purchasing apples in the fruit and vegetable department. Their participation in the study was intended to elicit an everyday language for the product. The RGM is an interview technique originally devised by George Kelly (1955) on the basis of his personal construct theory of personality. The method was chosen based on the results of a previous study by Hersleth et al. (2005), who compared a trained sensory panel’s perception of bread with consumers’ perception. The method has been successfully used to elicit words in a number of studies concerning food and descriptive analysis (Moussaoui and Varela, 2010, Hersleth et al., 2005, van Kleef et al., 2005, Andani et al., 2001). The present thesis used one-to-one interviews, a procedure which could be argued to be quite time-consuming, especially if a large number of consumers are needed. Chang et al. (2009) proposed an alternative way of conducting RGM by increasing the number of consumers and working with them as a group, similar to a panel, in different group sessions. However, when the present study was conducted, this type of procedure had yet to be evaluated and validated. One important difference between using a trained panel and using consumers could be that the trained panel are used to the environment and the procedure of sensory evaluation (Ishii et al., 2007), whilst consumers recruited in the
store are not; they might never have been interviewed or have participated in a research study before. However, the consumers were able to express any words without any definition or calibration, compared to the trained panel, using an everyday language (Lawless and Heymann, 1999, Civille and Lawless, 1986).

The data analysis followed the procedure described by Hersleth et al. (2005). To reveal the relationship between the perceptions a partial-least squares regression (PLSR) was used to study the covariance between elicited consumer constructs and descriptive data from the trained panel, as well as the covariance between consumers’ constructs (Martens and Martens, 2001). For further statistical details concerning this method see Hersleth et al. (2005) and Westad et al. (2003).

**Semantic frame theory**
The semantic frames were created using a qualitative analysis based on quantitative data (paper II). Frames for baby leaf salads were established based on the vocabularies from the trained sensory panel and the consumers (paper I). Some semantically pregnant words used by the consumers were also included to enable expansion and development of the sensory lexicon for these salads, using words from the consumers’ lexicon to capture linguistically unique sensory attributes and properties.

**Observational studies**
Two different prospective observational studies (Altman, 1999) were conducted to observe the consumers’ choice of product (papers III and IV). The observational studies were conducted in different grocery retail stores in Sweden. Consumers were asked to participate in the study. Those who agreed to participate were asked to evaluate the three alternatives in order to make a choice between the products (forced choice), taking into consideration the products’ sort name, sensory description, taste preference, visual appearance, and price respectively. All participants were obliged to have a preference; there was no “no preference” option. This approach was thought to be a suitable procedure for discovering whether the sensory description labels developed according to the results of papers I and II had any effect on consumer choice in general in a grocery retail store.
The first observational study was conducted over four different sessions (paper III), with data being collected independently between sessions. Three types of apple were presented in baskets on a table in the fruit and vegetable departments in two different grocery retail stores. Different labels were presented within each session to investigate their effect on the consumers’ choice behaviour. The sessions included (1) sort name, (2) sensory description, (3) sensory semantic description, and (4) sort name together with taste preference. The main difference between the sensory descriptions and sensory semantic descriptions was that the latter included some semantic words which are shown in italics in Table 2.

Table 2. Example of the sensory description and sensory semantic description for INGRID MARIE. Semantic words are shown in italics.

<table>
<thead>
<tr>
<th>Sensory description</th>
<th>Sensory semantic description</th>
</tr>
</thead>
<tbody>
<tr>
<td>INGRID MARIE</td>
<td>INGRID MARIE</td>
</tr>
<tr>
<td>Some citrus odour in flesh</td>
<td>Some citrus odour in flesh</td>
</tr>
<tr>
<td>Quite juicy, crisp, firm apple, some</td>
<td>Quite juicy, crisp, firm apple, some</td>
</tr>
<tr>
<td>chewing toughness</td>
<td>chewing toughness</td>
</tr>
<tr>
<td>Low sweetness, quite acidic</td>
<td>Low sweetness, quite acidic with a touch of lemon and orange</td>
</tr>
</tbody>
</table>

The design of the first observational study was limited to analysing the effect of the labels for three different products with a forced choice approach over a short time period. Differences in consumer choice behaviour between session and samples were considered significant with a p-value <.05 (paper III). The cumulative percentage frequency of consumer choice of apple for each session was used. To expand the data analysis, fitting to a nominal logistic regression model was used to analyse the probability of choosing an apple in each session (also see Table 1).

The second observational study (paper IV) aimed to take this investigation further, using three experiments to examine consumer choice behaviour, agreement and change in their choice, with different sensory marketing cues such as sensory description labels, taste preference, price, and visual appearance. Consumer’s agreement and change between the different variables were analysed as dependent data within each experiment to reveal their choice behaviour and change between each variable. Three varieties of tomatoes were selected for the study, based on the sensory...
method presented in paper I. The participants in paper IV were asked to make three different choices in each experiment, with different variables being presented in each experiment. The variables were presented one at a time, without interfering with each other. Taste preference was gauged via tomato wedges which were similar in size and shape between the three tomatoes, all sliced “a la minute” by a research assistant (a student from the Culinary Arts and Meal Science department). Each session included taste preference as second choice and price as the third choice after visual appearance (experiment one), unique selling points (USP) (experiment two), and sensory description (experiment three); see Table 3.

**Table 3.** The three different experiments (paper IV); visual appearance, USP labels, sensory description, taste preference, and price.

<table>
<thead>
<tr>
<th>Experiment</th>
<th>First choice</th>
<th>Second choice</th>
<th>Third choice</th>
</tr>
</thead>
<tbody>
<tr>
<td>Experiment I</td>
<td>Visual appearance</td>
<td>Taste Preference</td>
<td>Price</td>
</tr>
<tr>
<td>Experiment II</td>
<td>USP</td>
<td>Taste Preference</td>
<td>Price</td>
</tr>
<tr>
<td>Experiment III</td>
<td>Sensory description</td>
<td>Taste Preference</td>
<td>Price</td>
</tr>
</tbody>
</table>

The frequency distribution of these paired data sets in contingency tables reveals the patterns of change in choices and agreement. This method allows evaluation of the part of the observed change in the pattern both on a group and individual level. With this method we can evaluate attributable to the group separately from any presence of individual heterogeneity in change of choice. The analysis was further extended by conducting a t-test with significance set at p<.05 to clarify the differences between the consumers’ choices.

**Methodological considerations**
The studies do have some methodological issues that should be considered. Within the sensory analysis (paper I), there were a number of concepts which include different meanings in Swedish and in English, so it was not always easy to translate the different attributes and expressions. One example is the use of “flavour” in relation to the perception of food. The word “flavour” is often used to mean the total perception of a food, including its appearance, odour, taste, texture, sound, taste, and temperature. In Swedish, we usually use the word “smak” for “flavour”, which is translated to “taste” in English. However, within the textbook literature of
sensory science, the categories for the sensory description of food are divided into the subcategories of appearance, odour, texture/consistency, flavour, and taste (Meilgaard et al., 2006, Lawless and Heymann, 1999).

Some difficulties arose with the panel in connection with terms such as “citrus fruit”; it was quite difficult to calibrate the panel for this type of attribute, and they struggled to come to an agreement. Citrus fruit includes many different varieties of fruits, such as oranges, lemons, limes, and mandarins. The panel leader conducted different taste tests to provide different references for the word or category of “citrus fruit”, using his experience and creativity as a former chef. This was also done for “tropical fruit”, which includes other subcategories such as “banana”, “kiwi fruit”, and “pineapple”. A number of tools have been developed over the years to improve and enhance a person’s ability to describe the complexity of sensory characteristics. For example, the Wine Aroma Wheel developed by Nobel et al. (1987) has been used both to train sensory panels and to function as a aid for novice wine consumers in learning to describe and discriminate between different grape varieties and other factors. The wheel design has also been used for various food products (Pickering and Demiglio, 2008, Duffrin and Pomper, 2006, Piana et al., 2004, Bruneau et al., 2000, Berodier et al., 1997, Issanchou et al., 1995, Sinesio et al., 1990). The semantic analysis (paper II) in the present thesis was initially aimed at developing a sensory wheel, similar to that of Noble et al. (1987), for the specific products from the sensory analysis. However, it was discovered when trying to categorise the attributes and the subcategories that the words in the Wine Aroma Wheel developed by Noble et al., (1987) were proposed in different groups which could be interpreted as a bit vague. For example, olives, asparagus, and green beans were grouped together in the subcategory “canned/cooked”. In addition, the taxonomies were often asymmetrical in that the same word was sometimes used on several levels, for example “nutty” and “floral”. Since our attempt at using the model of a wheel failed, we returned to using the frames instead. The whole idea of the wheel is that it is meant to be a quick way of learning and recognising the aromas of the wine; first one looks at the inner tier of the wheel for words suitable for describing the flavour, such as “fruity”, and then moves to the outer tiers to find the more specific attributes, such as “raspberry”.

In present thesis, we were not able to use the semantic frame approach to the extent that we had initially intended, for example when developing the sensory description labels. We could only use a limited number of
words from the sensory analysis, since the RGM approach, in this case, includes only words occurring more than five times. The semantic frame analysis was conducted after the sensory analysis, and was based on the vocabulary used by the trained panel and consumers. Another possible approach would have been to develop the semantic frames before the sensory analysis, using information from the literature as a basis, and then to use these frames during the sensory evaluation to improve and enhance the participants’ ability to describe the complexity of the sensation, and hence perhaps to elicit more and more accurate words and extend the lexicon. The use of semantic frame theory was seen as an alternative tool when it comes to eliciting sensory attributes for food products from trained panel or consumers as shown in paper II, for example, the Wine Aroma Wheel (Noble et al., 1987).

The observational surveys (papers III and IV) involved asking consumers which product they preferred according to different variables. With this approach, we have no guarantee that they were telling the truth. However, this type of design does seem to be a suitable approach to eliciting some initial data on whether these labels have any effect on consumer choice behaviour in a grocery retail store. It should be further noted that while a consumer may say (and even believe) that they prefer a specific product, there is no guarantee that they will buy that product once they have left the testing situation. They may have a tendency to buy or choose one product more than another, for example. For buying preferences, or purchase intent, it is a preference that is strong enough to elicit consistent buying choice behaviour in the marketplace, all else (e.g. price and convenience) being equal. This kind of “operational preference” (a preference that is strong enough to elicit consistent choice behaviour, once the consumer has left the testing situation) was demonstrated by Witchukit and O’Mahony (2010). A possible solution would be to apply the “take away” test when conducting an observational survey like this in a grocery retail store. A take away test would be presented after the test, the consumers would be told to take away, one or several of the products that they had just tested to reveal a more real behaviour. This aspect is worth further consideration when conducting an observational survey like this, examining consumer choice behaviour, in relation to sensory description, taste preference, price, and visual appearance. It might give a hint of the “real world” behaviour. In general, investigation of consumer’s real preferences, shopping behaviour, may require monitoring the consumers and their behaviour for a
longer period of time, situational preference, which requires another approach.
Results and discussion

Sensory analysis and semantic frame theory
To be able to create a sensory language for food products that can be used for marketing by grocery retail stores and food companies, it was first essential to establish the relationship between how a trained sensory panel perceives and describes the sensory characteristics of different food products, and how untrained consumers perceive and describe these same products. In this first step (paper I), the trained panel agreed on a list of 18 sensory attributes to describe the sensory profile of eight varieties of red apples with definition. The consumers’ list of attributes was restricted to the 14 words that occurred more than five times. Comparison of the perceptions of the trained sensory panel and the consumers showed that they used similar vocabulary to describe these apples in terms of their texture, taste, and flavour attributes. This result is in accordance with previous studies (Worch et al., 2010, Seo et al., 2009, Ishii et al., 2007, Hersleth et al., 2005, Fillion and Kilcast, 2001).

Previous research has reported that different attributes are important for consumers’ preference; for example, Daillant-Spinnler et al. (1996) found that consumers could be divided by preferences into two groups: (1) firm and sweet, and (2) juicy and acidic. Additionally, it has been demonstrated in earlier research that consumers rated flavour and texture as the most important attributes when determining apple choice (Jaeger et al., 1998).

The results from the sensory analysis were then further analysed using semantic frame theory (paper II). The results revealed different frames for different categories; different frames can show the domains from which the words are sourced, for example “nutty”, “cabbage”, or “roots”. Reflection on this enables an expanded lexicon for further studies, including new words to investigate and use. For example, in order to expand the semantic frame for RUCCOLA, as in paper II, there are several ways to go. Words which derive from TEXTURE, ODOR and FLAVOUR or non-sensory attributes e.g. ORIGIN, PRICE, STORING, USE and the more. In this case, the concept evoked by the single word “nuts” within FLAVOUR is further used to expand the frame. The construction of a new frame for the word “nuts” would call for a sensory analysis in itself, to create a lexicon and a frame.
In this case, partial semantic frames for nuts were presented based on COLOUR (VISION) and TYPE, to get an idea of how to expand the frame. Another frame could have been developed by taking almond from the TYPE frame for nuts as a point of departure and evoking the sensory concepts included in almond.

This combination of the methods of sensory science and semantic frame theory (papers I and II) proved to be a fruitful interplay, and gave a new perspective on how to develop a sensory language for food products. The approach of combining sensory science and semantic frame theory provides a theoretical anchored language model which will be suggested as an alternative and facilitate communication of sensory qualities. However, further research is needed concerning the interplay between semantic frames and sensory evaluation. For example, we encountered some difficulties when creating the sensory language models and working out how to expand the sensory language, and so the frames were created on the basis of the language used in paper I. It might be beneficial to instead create a semantic frame for the product group of interest based on the literature and previous sensory analysis, and to then use the frames during the sensory evaluation, and actually expand the vocabulary during the training process and thereafter.

**Observational studies**

In order to draw any conclusions about how these sensory descriptions might they affect consumer choice behaviour, it is necessary to investigate them in a marketing situation. Hence, the results from papers III and IV were investigated in grocery retail stores. The findings from the two observational studies indicate that sensory description labels affect consumers’ food choice behaviour.

When only sort name was given (paper III), the consumers tended to choose the product with a more well-known name. They also did not spend very much time evaluating the labels; this is not particularly surprising, since there was not much information to evaluate. Grocery retail stores generally just market the sort name, price, and perhaps origin. The consumers pointed out that it was a fairly simple task to make a choice when only sort name was shown; one said: “This is an easy task... I chose INGRID MARIE, that’s my favourite apple, I buy it all the time”. How-
ever, when the products were presented with the addition of sensory description labels, the consumers’ choices shifted. For example, a product with a less well-known sort name which was not chosen when only the sort name was presented seemed to shift in frequency of choice when sensory descriptions were presented. Although the sensory semantic description labels included some extra attributes, they did not have any additional affect on consumer choice behaviour compared to the sensory descriptions. However, the number of words on the label seemed to be a critical aspect, the consumers seemed to struggle when comparing the alternatives which is also accordance with previous research which has been demonstrated that too much information might make it difficult for the consumers to remember and to make a proper evaluation of the labels (Bettman, 1979, Baars, 1997, Baddeley, 1997). Wansink (2004) also noted that too much information on the label would be critical for consumers when making a choice, and suggested the use of shorter descriptions. Hence, shorter labels were created, the USP labels in paper IV. However, the results in paper IV were similar to those in paper III, with no differences between the effects of sensory description labels and USP (unique selling points) labels on consumer choice behaviour.

The results of papers III and IV are in accordance with previous research (e.g. Wansink et al. 2005, 2001; Mueller et al. 2010a; and Lockshin et al. 2009). Wansink et al. (2005, 2001) investigated the effect of labels in a restaurant setting, and found that even fairly simple sensory descriptions resulted in increased sales and more positive consumer perceptions. For example, “Tender Chicken Parmesan” sold better than the regular menu item “Grilled Chicken”; the consumers saw the food as more appealing and perceived it as tastier, and showed increased intention to revisit the restaurant. These labels were developed by brainstorming within the research group, rather than by using a sensory and linguistic approach as in papers I and II to determine how the product is actually perceived by the consumers.

Consumers’ choices and ways of evaluating the different sensory description labels may vary between categories of products (low- or high-involvement products). For example, apples and olive oil might produce different results; olive oil could be theorised as a more complex and probably more expensive product which will last much longer and might be displayed in the kitchen as a symbol of good “taste”; when making a choice,
therefore, consumers might be willing to evaluate the label more thoroughly. The interviewer in the present study also made the overall observation that the consumers seemed to be more engaged in the choice when the sensory descriptions were shown; they appeared more curious about the alternatives and were quite thorough when reading and evaluating the labels in order to make a choice. However, this may have been partly because they knew they were participating in a study and also because they were forced to have a preference; their behaviour in this “test” situation may not have been the same as in a more “real” situation.

It has been highlighted in previous research that different attributes are important for consumer preference regarding products such as apples (e.g. juiciness, crispiness, sweetness and acid) (Jaeger et al., 1998, Daillant-Spinnler et al., 1996). It is essential to use the right type of attributes when communicating with consumers, both for credibility and to ensure that the consumers can actually relate to them (Hoegg and Alba, 2007a, Wansink et al., 2005, Wansink et al., 2001). For example, in paper III, the consumers expressed some negativity towards the attribute “perfume” for apples, which could affect their choice behaviour. This could be seen as an important aspect when it comes to marketing communication and how it affects consumer behaviour. For example, Loftus and Palmers (1974) found that different words and verbs had different effects on how consumers perceive and associate with an experience, in their case car crashes. It may therefore be worth considering further how different amplification words like “faint” and “very” may affect consumer choice behaviour.

Food labels are generally intended to provide consumers with the necessary information and knowledge about the product when searching for a product to buy and consume (Dimala and Skuras, 2005). The results of the present thesis also reveal that the relationship between consumers’ choice according to the information provided such as sensory description helped the consumers to chose a product which were quite consistent with their taste preference as well (paper IV). In other words, reading the labels helped the consumers to make a choice which was more in accordance with the perceived taste of the product. This means that the labels are well in line with the perceived taste of the product; Wansink et al. (2000) highlighted the importance of this relationship in ensuring that the product does not lose credibility in the eyes of the consumers. Products bought in a grocery retail store might be evaluated hours or days after they have been
purchased. Hence, whether the sensory descriptions are presented on the shelves or on the package may have an impact how the consumers are able to relate the information to perceived taste in a “real” situation. That means, for example if the description comes with the package the consumer could re-evaluate the label when consuming the product in contrast to description on shelves within the store. Wansink et al. (2004) suggested the use of a shorter description label on the front of the product (e.g. a bag of salad) and a longer sensory description on the back.

Price is often referred to as being the most important extrinsic cue used by consumers to determine a product’s quality (Monroe, 2003, Dodds et al., 1991, Monroe and Krishnan, 1985). In accordance with Fotopoulos and Krystallis (2003), who revealed that consumers might be willing to pay a higher price for apples with a quality label, the results in paper IV showed that the consumers seemed to be less price-sensitive when sensory descriptions were presented. It should be noted, however, that the price difference between the products in paper IV was quite large; if the price levels compared had been more similar, for example varying by only about 10-25%, the outcome might have been different. Still, the results do give us some hints about the way consumers choose food products with sensory description labels in relation to price. Our results are also consistent with the discussion by Olson (1977) who argued that an extra cue, such as information labels (sensory descriptions), will positively affect consumers’ price sensitivity. This interaction between sensory description labels and price needs to be further investigated for different food products. For example, tomatoes are considered as seasonal, and the price may vary between different times of the year, while apples such as Granny Smith have a relatively long season and are therefore more price-stable. However, as for the sensory description labels, where the information must be accurate and in accordance with the perceived taste in order to avoid the product losing credibility in the eyes of the consumer. The same thing goes for price, as argued by Dood et al. (1991), if a consumer’s experience is negative, they may not be willing to buy the product at all. Hence, this relationship needs to correspond well with the consumer’s expectations.

The observational studies in this thesis were conducted with a forced exposure, meaning that the consumers had to evaluate the labels and other information in order to make a choice. This is perhaps not a normal approach to grocery shopping, so it is quite difficult to generalise our results.
to see how the labels would affect the consumers in a more incidental exposure. It may be argued that in an incidental exposure situation, it might be hard enough for the labels to attract the attention of the consumers, let alone to get them to actually read and evaluate each label in order to achieve the goal of choosing a product. There are also many other factors which affect consumer behaviour when choosing food products in a normal grocery retail store, including the atmosphere in the store, the other people in the store, and exposure of the products in question (product placing). However, it may be worth conducting further studies of the effect of sensory description labels with an incidental exposure, and the present results do at least give some hints about the effect of using sensory descriptions in a grocery retail store.
General limitations

There are some general limitations of the present thesis which are worth considering. The sensory language generated was in Swedish, and hence translation of the words or attributes into English may be problematic, an issue that was highlighted in papers I and II. Words or attributes may not have the same meaning in other countries, cross-cultural effects (Hoegg and Alba, 2007a). In this case, we did not consider cross-cultural effects, gender, or age. The sensory marketing approach in the studies focused solely on fruit and vegetable products, but this approach may also be used for other products. It is worth remembering, however, that fruit and vegetables may vary in sensory quality due to their biological origin; in addition, the products used in the present thesis were available only in Sweden during a specific time period, which makes it somewhat difficult to replicate the sensory analysis.

There are also some general limitations to consider when interpreting the results from the observational studies (papers III and IV). For one thing, as mentioned above, the observation surveys conducted within the grocery retail stores did have a forced choice; the consumers were obliged to have a preference and to make a choice on the spot. This means that the results do not take into account the context effects which would be present in an incidental exposure situation. The next step in investigating the effect of sensory description labels on consumer choice of food products in a grocery retail store might be to study the consumer behaviour in a more natural situation, incorporating context effects. Finally, the experiments were also restricted to only three different products within each category and for each study.
Contributions

Each paper makes a specific contribution to the different fields. The subsections in this chapter highlight some of the more general contributions related to different fields such as grocery retail stores, retailers, marketers, and advertisers, as well as contributions to academic research.

Contributions to academic research

The present thesis mainly contributes to the growing literature in sensory science, linguistic science (semantic frame theory), and marketing science in showing how a sensory marketing approach within grocery retail stores could affect consumer food choice behaviour. Through a series of four papers, the thesis demonstrates how the different methods and theories of these research disciplines could be combined. As mentioned in the theoretical background, taste has been given only scattered attention within the field of sensory marketing, in contrast to vision and hearing (see review by Krishna 2010; and Peck and Childers 2008).

Within the field of sensory science, the development of a sensory language is a critical step when using human beings as a measuring tool to interpret and evaluate how we perceive different food products; we are not calibrated measuring tools that can give exact values for a certain stimulus. Papers I and II reveal a possible approach to expanding and developing a sensory language by means of semantic frames, which can be used when working with different groups of people, such as consumers or a trained sensory panel. To date, sensory scientists have predominantly relied on only a small number of methods and tools for categorising words and sensory attributes in order to expand the sensory language. Given this, the method of semantic frames is suggested as an addition to the alternatives. Also, this approach, combining sensory science and semantic frame, is appealing to new an interesting research question in how to improve the way we express ourselves in terms of sensory perception of food. The contribution to sensory science is an indication of how to use the sensory language further, both for companies and academia, and extends the use of the sensory science and sensory language being developed into a marketing tool. The present thesis demonstrates the relevance of collaboration between the research disciplines in the development of a sensory marketing approach. The thesis also reveals that using a large number of words may
not be as effective as we thought when consumers are searching for and choosing product. It could be argued that fewer and more appealing words may better trigger the consumers, initially. Hence, it is vital to know your product and to know which of its attributes are unique selling points, to be able to differentiate the product from its competitors. However, these attributes may also differ between product categories. Furthermore, previous research within sensory marketing focusing on taste marketing and labelling has not concentrated on the development of a proper sensory language. Instead, for example, Wansink (2005, Wansink et al., 2001) brainstormed the names and description. It is essential to understand the consumers, how they perceive the food products, and how they express these perceptions.

Combining the methods and theories from sensory science and marketing to create and develop a sensory language for use in marketing is a relatively new approach to the existing literature in marketing science. This kind of approach reveals the importance of understanding the consumers and how they actually perceive different products, in this case food; by doing this, we can understand how the consumers will interact with the products. The present thesis reveals a possible approach within sensory marketing in how to integrate and engage our senses (taste) into the consumers’ shopping behaviour, and hence offer a more compelling product.

Sensory marketing is a growing field of research, within which different researchers have been working with different senses and with different aims. The present thesis offers an interesting interplay within the research field of Culinary Arts and Meal Science (CAMS), and suggests more research devoted to sensory marketing within this field. Hopefully, academics within CAMS will also offer some sensory marketing courses in the future, with a focus on food and taste.

**Contribution for grocery retail stores and retailers**

Most of the people working within grocery retail stores today, such as floor workers, store or department managers, and store owners, have only limited knowledge concerning the sensory qualities of the food products sold in their store. This lack of knowledge among the staff leaves the consumer to depend solely on their own knowledge and experience of the food product itself; the staff are able neither to inform consumers about the
product’s capabilities or features nor to help the consumers to make a new and inspiring choice of food. The job of guiding the consumer is left to the shelf information, packaging, labels and other advertisements offered within the store. Given this, the present thesis suggests that communicating the sensory characteristics of food products on labels, packaging, signs, and so on may be a possible way to improve the marketing communication within grocery retail stores. However, it is also important for the supply chain managers and staff within grocery retail stores to develop their knowledge about the products they are selling, so they can communicate and help the consumers on the floor as well. One suggestion arising from the present thesis would be to encourage the people working with food products to actually taste and evaluate the sensory characteristics of the products they are selling. It is also suggested that grocery retail stores use a simplified version of the RGM (repertory grid method), which has been shown to be a helpful method when it comes to describing perceived taste in a simple way (paper I).

It is a challenge for grocery retailers to keep consumers loyal to their store and encourage them to revisit the store. It could be suggested that they need to learn how to stimulate the consumer’s senses, in this case taste, in order to inspire and satisfy the consumers’ needs in their search for food products to purchase. Taste sampling within the store is considered an appropriate way of promoting a food product and its sensory characteristics, and convincing consumers to make a first-time purchase (Sprott and Shimp, 2004). However, as it is not possible to serve taste samples for all the products within a store, retailers must rely on other marketing communication strategies, such as sensory marketing with a focus on taste. Furthermore, developing different sensory descriptions for different products and categories has proved to be quite a complex procedure. It is vital that these sensory descriptions are unambiguous, and therefore it is also suggested that they are kept uniform within the supply chain.

**Contributions for marketers and advertisers**

The product is the key element in the overall marketing offering, and companies need to formulate an offering which brings value to the target consumers. Hence, the food product’s sensory characteristics may be one of the most powerful marketing tools, due to the fact that eating quality has a direct impact on how the products will be evaluated by the consumers. Companies may spend a lot of money developing their brand image, and
often use a specific language to do so, such as brand names, slogans, and sometimes trivial attributes, in order to differentiate between themselves and their competitors. The present thesis demonstrates a possible way to market a food product without using any trivial or irrelevant attributes, but rather using descriptive attributes related to the product’s sensory characteristics.

The design of the product plays an important role in attracting and appealing to the consumer’s attention in the grocery retail store, and the packaging acts as an important link in the advertisement of the brand. However, today’s consumers are becoming more sophisticated and demanding about the products that they buy and consume. As suggested in the present thesis, a sensory language might be a suitable addition to today’s marketing and advertising strategy, in order to appeal to and attract the consumers’ senses when shopping for food in a grocery retail store. This thesis focuses on taste, and how marketers and advertisers can affect consumers’ behaviour and perhaps in the future establish a deeper sense of brand loyalty and consumer satisfaction. There are a few grocery retail chains around the world that communicate the sensory quality of their food products. Two examples are Waitrose and Sainsbury in the UK, which actually communicate taste experience and sensory quality in their TV commercials for their own-label products. For example, Waitrose is assisted by the famous chef Heston Blumenthal from the Fat Duck Restaurant, who talks about the advantageous sensory characteristics of the food and at the same time inspires the consumers with ideas for what to do with the product. These grocery chains do not yet use a sensory marketing approach in terms of a sensory language on their packaging, shelves, labels, and so on; but this is most probably on its way.

Developing a sensory language may be quite a complex task, and companies are advised to seek help from their sensory staff, copywriters, and marketers to achieve this. For example, sensory staff could adapt a simplified version of the method used in paper I. The semantic frame approach might be a helpful tool for use by copywriters, marketers, advertisers, brand managers, and so on, to expand their language. Consumers are usually faced with descriptions such as “tasty”, “premium”, or “balanced flavour/well balanced”; in order to appeal to them more effectively, this type of marketing language might need to be expanded and become more
objective and accurate. The present thesis gives some examples of how to do this, and reveals how this affects consumer choice behaviour.
Concluding remarks

To sum up, the aim of the present thesis was to develop a sensory marketing approach for grocery retail stores by combining different methods and theories from the research disciplines of sensory science, linguistic science (semantic frame theory), and marketing science.

By applying different methods and theories of sensory science, we were able to use human beings as a measuring tool to evaluate and interpret how we perceive different food products. How we express ourselves when describing a taste experience is quite complex and not an easy thing to do. We found that a trained sensory panel and consumers did use similar vocabularies and descriptions, but struggled somewhat when trying to expand terms such as “tropical fruit” to a more specific description. By applying semantic frame theory we were able to expand and develop the sensory language elicited from the trained sensory panel and the consumers. We did not find any differences between sensory description labels and sensory semantic description labels in terms of their effects on consumer choice behaviour. Shorter sensory description labels, the USP labels, also showed no difference in effect from the longer descriptions. The shorter USP labels could be a more effective way to make the initial communication with the consumers. However, these labels and their descriptions may vary between different categories; for example, apples may have to be treated in a different way to olive oil. Given this, it is relevant to create sensory language models or sensory descriptions that the consumers will read and comprehend when making a food choice. Consumers are not generally able to taste products before the purchase, and therefore a sensory description with accurate and relevant information may be helpful.

In this case, we found that the sensory description labels did affect the consumers’ food choice in the grocery retail store. The consumers tended to shift in choice when given different information. For example, and not very surprisingly, when only the sort name was shown, they chose the most well-known product. However, when the sensory characteristics were shown, the product which was considered less well-known was chosen with the highest frequency. We also found that consumers tended to be less price-sensitive when they were shown a sensory description label. The consumers will most likely be able to determine the sensory quality after the actual purchase, though it could be hours or even days before they actually taste the product. Hence, it is important that the consumers are able to perceive what the sensory description on the label or package is telling them to expect upon consumption of the product.
A sensory marketing approach with a focus on taste may be an alternative marketing tool when trying to affect consumer choice behaviour and shopping behaviour in the grocery retail store. The present thesis indicates that this type of research is of relevance and should be pursued further in order to inspire and help the consumers when doing their grocery shopping.
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SENSORY AND SEMANTIC LANGUAGE MODEL
FOR RED APPLES

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ABSTRACT
This study (1) examines the sensory attributes of a large group of red apples and compares consumer perceptions of them with those of a trained sensory panel; and (2) uses a sensory semantic frame classification to analyze the vocabulary used. Descriptive analysis was carried out with the trained panel, while a simplified version of the repertory grid method was used for one-to-one interviews with consumers. The perceptions expressed by the consumers correlated quite well with the terminology used by the trained panel, and the two groups used many identical words when describing the apples' texture, flavor and taste according to partial least squares regression. A sensory semantic frame was constructed based on the vocabulary used by the two groups. The combination of sensory and semantic analysis could be one way of extracting valuable words for use in contexts such as product description for marketing purposes in retail stores.

PRACTICAL APPLICATION
To increase and optimize consumer experiences of fruits and vegetables, it is crucial to use the proper words, both informatively and esthetically, to express these sense experiences. Often, however, it can be difficult to describe the taste, flavor, scent and texture of the food we eat. An agreed-on sensory and semantic language for apples, for example, could be valuable for effective communication in retail stores, to improve selling statistics, consumption and consumer quality awareness.

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ABSTRACT

This study (1) examines the sensory attributes of a large group of red apples and compares consumer perceptions of them with those of a trained sensory panel; and (2) uses a sensory semantic frame classification to analyze the vocabulary used. Descriptive analysis was carried out with the trained panel, while a simplified version of the repertory grid method was used for one-to-one interviews with consumers. The perceptions expressed by the consumers correlated quite well with the terminology used by the trained panel, and the two groups used many identical words when describing the apples’ texture, flavor and taste according to partial least squares regression. A sensory semantic frame was constructed based on the vocabulary used by the two groups. The combination of sensory and semantic analysis could be one way of extracting valuable words for use in contexts such as product description for marketing purposes in retail stores.

PRACTICAL APPLICATION

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The key outcome of the study is that the perceptions of the trained panel and the consumers were quite similar, and that the combination of sensory and semantic methodology could be a valuable tool to create sensory characteristics of products to be used in effective marketing communication in grocery retail stores. Future research could investigate consumer decision-making in relation to sensory and semantic description labels in retail grocery stores.

INTRODUCTION

The sensory quality of apples is critical to producers, retail stores and consumers. Hence, a sensory language for apples could be important for effective communication in retail stores. Researchers have already developed a number of different kinds of terminologies, lexicons, for food products, e.g., tomatoes (Hongsoongnern and Chambers 2008), bread (Hayakwa et al. 2010) and almonds (Civille et al. 2010). As consumers become more demanding about the quality of the apples they buy, it becomes more important to understand the sensory perception of apples in order to improve the marketing process for grocery retail stores. There are already a few food-producing companies in Sweden that inform their customers of (among other things) the sensory attributes of their products; for example, the Swedish alcohol retail monopoly, Systembolaget (2008). Past work has shown that descriptive names improved sales and expectations related to food and restaurants (Wansink and Painter 2001). Therefore, it would be of interest to investigate whether it is possible to increase consumers’ expectations of apples through a sensory language. To increase and optimize the experience of an apple, it is essential to use the concordant words when describing or communicating the product’s sensory attributes to the customer.

Perception and verbalization by both a trained panel and consumers could act as guidance toward sensory descriptions of apples. Previous studies have been comparing the consumers’ and trained panel’s perceptions of food with good agreement between the two groups (Gómez et al. 1998; Andini et al. 2001; Fillion and Kilcast 2001; Hersleth et al. 2005). To be considered when comparing the two groups is that the trained sensory panel develops a scientific language, very precisely defined, and consumers use an everyday language used in daily conversation (Lawless and Heymann 1999). Still, the two groups are representative of the consumer. However, the relationship between the two group’s perception and used words for apples needs to be investigated for further establishment.

Describing perceptions is difficult, because doing so does not mean simply transcribing reality but expressing individual sensations in one’s own language. Thus, it is crucial to agree on an intersubjective sensory lexicon for
different categories of food items. A most valuable discipline in this pursuit is lexical semantics. From a semantic point of view, components in and around word meaning can be mapped in detail (Cruse 1986; Aitchison 1994). Some examples of such components would be: (1) sense – what can be said to be the meaning of a certain word; (2) inherent concepts – various concepts are housed in a certain word, such as “red” in the word blood; (3) semantic domains – words belong to different superordinates, such as lemon to citrus; (4) specification – the word lemon is more specific than the more general citrus, which in turn is more specific than fruit; and (5) information – words such as tasty and delicious lack objective information and are thus difficult to define semantically, which is not the case of, for example, cabbage and strawberry where the conceptual content is more obvious.

In cognitive semantics, the focus is on how we understand and process words mentally, and on the correspondence between word meaning, concepts and referents in the extra-linguistic world. One way to approach word meanings is to use a so-called semantic frame. A semantic frame comprises a description and representation of how our mental lexicon is organized in the long-term and in the working memory, and of how experiences stored there are linked to different words (Barsalou 1992; Barsalou et al. 1993; Fillmore 2005). In the version of Barsalou (1992), the point of departure is that the conceptual aspect of every word has several attributes, which in this context can be visualized as a set of empty slots that are actualized on encountering a certain spoken or written word. For the word apple, some of the attributes would be skin color, flesh color, aroma, type, and use. These attributes could have conceptual values such as “red” (skin color), “light yellow” (flesh color), “perfume”, “vanilla” and “honey melon” (aroma), “Gravensteiner” (type) and “dessert” (use). Another example would be the semantic relation between the two words bird and fly, which belong to different word classes. This is impossible to capture in terms of lexical relations such as hyponymy or meronymy (Cruse 1986). However, within a semantic frame the relation is easily described in terms of attributes and values: bird has as one of its attributes ability, for which “fly” is one of several values. But the word bird contains other concepts such as “wings” (value of part), “egg” (value of birth), “nest” (value of dwelling place), and so on. Thus, a semantic frame is built on an empirically grounded theory of how the internal conceptual pattern of words can be described, and of how words are linked to each other in our mental lexicon.

Crispness and crunchiness are among the key attributes associated with pleasant texture in various fruits and vegetables (Fillion and Kilcast 2001). Sensory quality of apples was described by taste, crispness and juiciness (Peneau et al. 2006). Furthermore, surveys have also found segmentation among consumer preferences, preferences for apples mainly being based on
To communicate these sensory qualities, we may need to develop and use a theoretically anchored language model if we are to find the proper expressions to capture the sensory attributes. A semantically anchored model enables systematicism and lexical precision in sensory expression. The words (and also other elements of language, such as morphemes and phrases) used in communicating sensory qualities are important, of course; if the proper words are not used, the desired qualities are not captured and cannot be communicated. Combining the sensory data with a method based on lexical semantics and semantic frame theory might be a way to develop and optimize communication of the sensory qualities of the product.

The aims of this study is (1) to examine the sensory descriptions of a group of apples and to compare consumer perceptions with those of a trained sensory panel; and (2) to use lexical semantics and semantic frames to (1) analyze the vocabulary used by the trained panel and the consumers; and (2) form a sensory semantic frame based on this vocabulary.

**MATERIALS AND METHODS**

The design of the study included several steps, using both quantitative and qualitative methods (see Fig. 1). In the first step, two different sensory investigations were conducted: descriptive analysis (DA) was used with a trained panel and repertory grid method (RGM) with consumers. In the second step, the vocabularies used by the consumers and the trained panel were compared with see whether they used similar descriptions of the sensory attributes. Finally, the third step comprised a semantic classification of the sensory vocabulary.

**Samples**

Eight different varieties of red apples were studied: Aroma, Cox Orange, Elise, Ingrid Marie, Red Aroma, Rubinstar, Jonagold and Royal Gala. The
apple samples were selected for their commercial relevance according to grocery store sales statistics, and by the season for the red apple species. The samples were stored at 6°C, in line with instructions from responsible purveyors, and were equilibrated to room temperature before the sensory evaluation analysis.

Most of the apples were obtained from a pack house in the south east of Sweden, Kivik, the exceptions being Jonagold and Royal Gala, which came from pack houses in Kerdiel, Holland and Bourges, France, respectively. All apple samples were harvested within the 45-day period before sensory evaluation. All apples were pre-sorted by size and colors at the Äppelriket pack house in Sweden, except for Jonagold and Royal Gala, which were sorted in the laboratory, so that all fruit samples represented the most common size and color for each species. Each fruit was washed in purified water and served as a whole apple on a white tray with a paring knife.

Panelists

A 12-member panel of students was recruited from the School of Hospitality, Culinary Arts and Meal Science at Örebro University in Sweden. Panelist were selected based on availability and motivation, screening test was carried out to determine ability to detect, discriminate and elicit sensory attributes related to the study (Meilgaard et al. 2006).

The assessment took place in separate booths at a normal ambient room temperature of 20°C in the sensory laboratory.

All products were evaluated by descriptive sensory profiling. The panel was trained and calibrated for a total of 25 h over 12 training sessions during a 3-week period. The assessors developed a list of attributes and agreed on a consensus list for the profiling and on the definitions of each attribute. In the first training session, panelists were presented with different kinds of apple samples and asked to brainstorm flavor and texture descriptors. In the next step, these terms were compiled and used for subsequent testing and discussion of different reference samples. The reference samples were selected by the panel and panel leader with different varieties of apples and maturity stages selected for most of the attributes; citrus, tropical fruit (i.e., kiwi, pineapple, mango, banana and passion fruit) and pears were also used. For the basic taste standards with different basic taste solution was used. Discussions in the panel led to the establishment of points of reference to help it identify different attributes, intensity differences, and ways to evaluate the sample. Furthermore, the assessors were trained and calibrated using an unstructured 9-point intensity scale. The panel leader used the PanelCheck (V.1.3.2, PanelCheck software [2006] Nofima Mat, As, Norway) program to monitor assessor ability to perform during training. Using line plot with a focus on the assessors,
PanelCheck provided useful data at the sample level to give information about how a specific assessor rated a sample (i.e., too high too low) compared with other assessors and on different replicates, and about variation between assessors for each attribute. The 18 selected sensory attributes of the apples are described in Table 1.

The panel evaluated the samples at individual speed using an unstructured intensity scale, presented on a computer screen using the FIZZ software (Version 2.00 E, Biosystèmes, Courternon, France), ranging from low (1) to high (9). The eight samples were tested in two sessions, four before a break and four afterwards with replicate. Panelists were asked to eat crackers and drink some water between samples. The samples, which were served on a white tray in a randomized order, were identified with a three-digit code, and the design was balanced for order and carryover effects. Segments were cut from apples with a packing knife by the panelist, if possible to include both the sun-exposed and shaded portion of the apple.

### Table 1.

**FINAL LIST OF 18 SENSORY DESCRIPTIVE TERMS (ENGLISH AND SWEDISH) WITH DEFINITIONS DEVELOPED FOR THE EVALUATION OF 8 RED APPLES IN SENSORY PROFILING**

<table>
<thead>
<tr>
<th>Attributes in English</th>
<th>Attributes in Swedish</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td>Odor</td>
<td>Doft</td>
<td>Intensity of odor from the skin of the apple</td>
</tr>
<tr>
<td>Skin odor</td>
<td>Doft skal</td>
<td>Intensity of odor from the flesh of the apple</td>
</tr>
<tr>
<td>Flesh odor</td>
<td>Doft fruktkött</td>
<td>Associated with citrus odor</td>
</tr>
<tr>
<td>Citrus</td>
<td>Citrus</td>
<td>Associated with soil odor</td>
</tr>
<tr>
<td>Soil</td>
<td>Jordig</td>
<td>Associated with grassy odor</td>
</tr>
<tr>
<td>Grassy</td>
<td>Gräsig</td>
<td></td>
</tr>
<tr>
<td>Texture</td>
<td>Textur</td>
<td></td>
</tr>
<tr>
<td>Juiciness</td>
<td>Saftighet</td>
<td>Amount of juice from the first bite</td>
</tr>
<tr>
<td>Tenderness</td>
<td>Mörhet</td>
<td>The force needed to masticate the fruit ready for swallowing</td>
</tr>
<tr>
<td>Crispiness</td>
<td>Krispighet</td>
<td>How crisp the apple seems during chewing</td>
</tr>
<tr>
<td>Graininess</td>
<td>Grynhett</td>
<td>Amount of granules felt in the mouth</td>
</tr>
<tr>
<td>Firmness</td>
<td>Fasthet</td>
<td>The force required to bite through the sample</td>
</tr>
<tr>
<td>Skin bits</td>
<td>Tuggmotstånd skal</td>
<td>Measure of tough the skin is</td>
</tr>
<tr>
<td>Taste</td>
<td>Smak</td>
<td>One of the basic taste e.g., sucrose</td>
</tr>
<tr>
<td>Sweet</td>
<td>Sötma</td>
<td>One of the basic taste e.g., citric acid</td>
</tr>
<tr>
<td>Acidic</td>
<td>Syrlighet</td>
<td>One of the basic taste e.g., quinine</td>
</tr>
<tr>
<td>Bitter</td>
<td>Bitter</td>
<td></td>
</tr>
<tr>
<td>Flavor</td>
<td>Smak</td>
<td></td>
</tr>
<tr>
<td>Astringent</td>
<td>Strävhett</td>
<td>Dries the surface of the mouth, like tannic acid</td>
</tr>
<tr>
<td>Pear</td>
<td>Päron</td>
<td>Flavor associated with pears</td>
</tr>
<tr>
<td>Flavor intensity</td>
<td>Smakintensitet</td>
<td>Intensity of the sum of all flavors</td>
</tr>
</tbody>
</table>

Consumers
The consumer investigations were held in conjunction with the trained panel investigation, to prevent any deterioration of sample quality. Two retail stores in two cities in Sweden were used to recruit for and conduct the consumer investigation. The recruiting took place in the fruit and vegetable department, and a total of 34 consumers were selected according to the criteria of being a frequent user and liker of the investigated product (Moskowitz et al. 2006).

The number of consumers in this study was based on previous investigations concerning development of vocabulary development and the comparison of trained panel and consumer perceptions using RGM (Hersleth et al. 2005).

Participants were asked to be interviewed for approximately 40–60 min. The consumers were 31–75 years old (mean 53), with a balanced mix of genders.

**RGM**
The RGM (Kelly 1955) was used to investigate the consumers’ perception of the products in one-to-one interviews consisting of three parts (Gains 1994; Fransella et al. 2003). The RGM has successfully been used in several investigations aiming to develop an extensive vocabulary for food products (Gains 1994; Hersleth et al. 2005) and apples (Jaeger et al. 1998; Gómez et al. 1998; Andini et al. 2001), so the method is suitable for vocabulary development (Gains 1994).

First, the interviewer conducted a warm-up session to make the consumer feel relaxed and comfortable with the situation; this session did not focus on sensory perception. In the second phase, the samples were arranged in groups of three (triads) in three sessions, such that each sample appeared in at least one triad and one sample from each triad was carried over to the next triad. Each triad was presented to the subject with the information that two of the objects of the triad were more alike, i.e., associated with each other and dissociated from the third item, the purpose being to eliminate any confusion in the mind of the untrained assessor caused by triadic presentation. The consumer was then asked to describe how they thought the two associated samples resembled each other and, likewise, how they differed from the third. After as many attributes as possible had been elicited, the consumer was given a break of approximately 10 min.

Dry crackers and water were consumed between the triads. In the third phase, the consumer was asked to evaluate the same samples again and provide his or her own evaluation of the attributes using an unstructured intensity scale of 1–9. The samples, served in a randomized order, were identified with a three-digit code, and the design was balanced for order and carryover effects.
PanelCheck provided useful data at the sample level to give information about how a specific assessor rated a sample (i.e., too high too low) compared with other assessors and on different replicates, and about variation between assessors for each attribute. The 18 selected sensory attributes of the apples are described in Table 1.

The panel evaluated the samples at individual speed using an unstructured intensity scale, presented on a computer screen using the FIZZ software (Version 2.00 E, Biosystèmes, Courtenon, France), ranging from low (1) to high (9). The eight samples were tested in two sessions, four before a break and four afterwards with replicate. Panelists were asked to eat crackers and drink some water between samples. The samples, which were served on a white tray in a randomized order, were identified with a three-digit code, and the design was balanced for order and carryover effects. Segments were cut from apples with a packing knife by the panelist, if possible to include both the sun-exposed and shaded portion of the apple.

**TABLE 1.** FINAL LIST OF 18 SENSORY DESCRIPTIVE TERMS (ENGLISH AND SWEDISH) WITH DEFINITIONS DEVELOPED FOR THE EVALUATION OF 8 RED APPLES IN SENSORY PROFILING

<table>
<thead>
<tr>
<th>Attributes in English</th>
<th>Attributes in Swedish</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td>Odor</td>
<td>Doft</td>
<td>Intensity of odor from the skin of the apple</td>
</tr>
<tr>
<td>Skin odor</td>
<td>Doft skal</td>
<td>Intensity of odor from the flesh of the apple</td>
</tr>
<tr>
<td>Citrus</td>
<td>Citrus</td>
<td>Associated with citrus odor</td>
</tr>
<tr>
<td>Soil</td>
<td>Jordig</td>
<td>Associated with soil odor</td>
</tr>
<tr>
<td>Grassy</td>
<td>Gräsig</td>
<td>Associated with grassy odor</td>
</tr>
<tr>
<td>Texture</td>
<td>Textur</td>
<td></td>
</tr>
<tr>
<td>Juiciness</td>
<td>Saftighet</td>
<td>Amount of juice from the first bite</td>
</tr>
<tr>
<td>Tenderness</td>
<td>Mörhet</td>
<td>The force needed to masticate the fruit ready for swallowing</td>
</tr>
<tr>
<td>Crispiness</td>
<td>Krispighet</td>
<td>How crisp the apple seems during chewing</td>
</tr>
<tr>
<td>Graininess</td>
<td>Grynighet</td>
<td>Amount of granules felt in the mouth</td>
</tr>
<tr>
<td>Firmness</td>
<td>Fasthet</td>
<td>The force required to bite through the sample</td>
</tr>
<tr>
<td>Skin bits</td>
<td>Tuggmotstånd skal</td>
<td>Measure of tough the skin is</td>
</tr>
<tr>
<td>Taste</td>
<td>Smak</td>
<td></td>
</tr>
<tr>
<td>Sweet</td>
<td>Sötma</td>
<td>One of the basic taste e.g., sucrose</td>
</tr>
<tr>
<td>Acidic</td>
<td>Syrlighet</td>
<td>One of the basic taste e.g., citric acid</td>
</tr>
<tr>
<td>Bitter</td>
<td>Bitter</td>
<td>One of the basic taste e.g., quinine</td>
</tr>
<tr>
<td>Flavor</td>
<td>Smak</td>
<td></td>
</tr>
<tr>
<td>Astringent</td>
<td>Strävhet</td>
<td>Dries the surface of the mouth, like tannic acid</td>
</tr>
<tr>
<td>Pear</td>
<td>Päron</td>
<td>Flavor associated with pears</td>
</tr>
<tr>
<td>Flavor intensity</td>
<td>Smakintensitet</td>
<td>Intensity of the sum of all flavors</td>
</tr>
</tbody>
</table>

Consumers

The consumer investigations were held in conjunction with the trained panel investigation, to prevent any deterioration of sample quality. Two retail stores in two cities in Sweden were used to recruit for and conduct the consumer investigation. The recruiting took place in the fruit and vegetable department, and a total of 34 consumers were selected according to the criteria of being a frequent user and liker of the investigated product (Moskowitz et al. 2006).

The number of consumers in this study was based on previous investigations concerning development of vocabulary development and the comparison of trained panel and consumer perceptions using RGM (Hersleth et al. 2005). Participants were asked to be interviewed for approximately 40–60 min. The consumers were 31–75 years old (mean 53 ± 12), with a balanced mix of genders.

RGM

The RGM (Kelly 1955) was used to investigate the consumers’ perception of the products in one-to-one interviews consisting of three parts (Gains 1994; Fransella et al. 2003). The RGM has successfully been used in several investigations aiming to develop an extensive vocabulary for food products (Gains 1994; Hersleth et al. 2005) and apples (Jaeger et al. 1998; Gómez et al. 1998; Andini et al. 2001), so the method is suitable for vocabulary development (Gains 1994).

First, the interviewer conducted a warm-up session to make the consumer feel relaxed and comfortable with the situation; this session did not focus on sensory perception. In the second phase, the samples were arranged in groups of three (triads) in three sessions, such that each sample appeared in at least one triad and one sample from each triad was carried over to the next triad. Each triad was presented to the subject with the information that two of the objects of the triad were more alike, i.e., associated with each other and dissociated from the third item, the purpose being to eliminate any confusion in the mind of the untrained assessor caused by triadic presentation. The consumer was then asked to describe how they thought the two associated samples resembled each other and, likewise, how they differed from the third. After as many attributes as possible had been elicited, the consumer was given a break of approximately 10 min.

Dry crackers and water were consumed between the triads. In the third phase, the consumer was asked to evaluate the same samples again and provide his or her own evaluation of the attributes using an unstructured intensity scale of 1–9. The samples, served in a randomized order, were identified with a
three-digit code. The number of words used by the consumers ranged from 8 to 22 with a mean of 15.

Data Analysis

Data from the descriptive analysis were analyzed using analysis of variance (ANOVA), with assessor effect and interaction terms as random effects. Attribute as dependent variable, sample as fixed factor and assessors as random to identify sensory attributes that differentiated between samples with significant level $P < 0.05$ were conducted.

The average responses to the replicates by the trained panel for each attribute were used in the multivariate analyses. Attributes that occurred more than five times among the 34 consumers were also included in the multivariate analysis. Principal component analysis (PCA) was initially used when analyzing the two groups (trained panel and consumers) separately and to study the main source of systematic variation in the elicited consumer constructs and the variation in the average sensory descriptive data. A partial-least squares regression (PLSR) was used to study the covariance between elicited consumer constructs and descriptive data from the trained panel and covariance between elicited consumer constructs. The variables were not standardized, and full cross validation were applied. PLSR is a multivariate technique. Qualitative indicator variables (0/1) will be used as independent X variables, where the attributes used by the trained panel serve as independent variables (X variables), with the sample as dummy and the attributes used by the consumer are the dependent variables (Y variables) (Martens and Martens, 2001). Correlation loading plots were applied, with the inner circle explaining $50\%$ and the outer circle $100\%$ of the variance (Westad et al. 2003). For further statistical details concerning this method see Hersleth et al. (2005) and Westad et al. (2003).

Semantic Analysis

The word material of the trained panel and consumers was first analyzed into one of the two groups objective and subjective, since subjective (affective) words mostly lack semantic information. The objective words were analyzed in a sensory semantic frame for apple. Thus, so far in this project, the semantic frames have mainly been used to semantically sort the words gathered from the trained panel and the consumers (e.g., exactly what conceptual aspect of apple is captured by the word graininess) and to clarify the meaning and conceptual profile of words such as crisp. The sensory semantic frame presented was originally based on a Swedish vocabulary. When translating the words from Swedish into English, the following works were consulted: the LEXIN online dictionary (Lexin Online, December 2008–January 2009), Stora engelsk-svenska ordboken (1980), and Webster’s online
dictionary (December 2008–January 2009). Some reflections on translation problems are to be found in the Results & Discussion section. In this section, three semantic frames are presented.

RESULTS & DISCUSSION

Sensory Attributes of Apples: Definitions and Assessment Performed by the Trained Panel

The trained panel agreed on a list of 18 sensory attributes to describe the sensory profile of eight varieties of apples (see attribute definitions in Table 1). According to ANOVA, four of the attributes from the descriptive data showed no significant difference, in terms of mean values or standard deviation, between the apple samples. In Fig. 2 the significant attributes are within the circles indicating 50 and 100 % variance, respectively. Three of these – grassy odor, soil odor and bitter taste – were also revealed by the first version of the PCA correlation loading plot to lie in the area with less than 50% explained variance, and were therefore removed from the dataset. The forth attribute, pear odor, was kept for further analysis because it lay in the region with more than 50% explained variance. A PCA correlation loading plot was then made on the basis of the remaining data, 15 attributes and eight samples, with samples indicated as dummy variables. PC1 accounted for 58% and PC2 for 25% of the total variation.

FIG. 2. CORRELATION LOADINGS PLOT FROM PRINCIPAL COMPONENT ANALYSIS OF DESCRIPTIVE SENSORY DATA FROM THE TRAINED PANEL WITH PRODUCTS INDICATED AS DUMMY VARIABLES (PC1 = 58 %; PC2 = 25 %)
PC1 was revealed to be related to the texture attributes of tenderness and graininess on the left side of the plot, and crisp and firmness on the right side. PC1 also described variation of the attributes of sweet taste and pear flavor on the left side and acidic taste and astringency on the right side. PC2 the attributes of pear odor, skin odor, flesh odor, flavor intensity and juiciness along the upper part and skin toughness along the lower part. However, according to earlier studies, preference for taste and texture correlates well (Daillant-spinnler et al. 1996), so it is not that surprising to see both taste and texture on PC1 and not a clear separation.

The ELISE apple was positioned on the right-hand side along PC1; it was described by the trained panel with some astringency and a relatively high intense for crispness, and firmness, and it differed significantly from the other samples in these attributes. ELISE was also positioned in the plot as having some citrus odor, flesh odor, acidic taste and flavor intensity but not here that mean values were relatively low. Note that the interpretation of the samples positioned in the centre of the PCA-figure mainly relies on mean values from Table 2; INGRID MARIE was positioned in the centre of the PCA figure, with an inclination toward the right side of the PC1, and could be described as quite crisp and firm with relatively high skin toughness and some intensity of citrus odor. RUBINSTAR and RED AROMA were positioned close together, also quite near the centre of the PCA figure, but RED AROMA was also described as being crisper and more acidulous than RUBINSTAR (Table 2). AROMA ST and JONAGOLD were positioned on the upper left side of the figure; they were perceived by the trained panel as being tender and quite grainy, sweet and with some pear flavor along PC1 (see Fig. 2a and Table 2).

AROMA ST and JONAGOLD were also described as having a quite high intensity of juiciness with some pear odor and relatively high intense of skin odor along PC2. ROYAL GALA and COX ORANGE were positioned fairly near to each other on the lower end of PC2, with neither a high nor a low intensity for most of the attributes, with the exception of skin toughness. The JONAGOLD apple was also perceived as juicy in earlier investigations by Andini et al. (2001) however, the trained panel in this study described the apple as having attributes of watery flavor and hard and crisp texture. The attributes crisp and hardness (firmness in this case) are positioned on the opposite side of juicy for JONAGOLD in Fig. 2. COX ORANGE was perceived as being quite grainy in texture according to the mean value in Table 2.

However, origin, harvest period and storage may affect sensory attributes, making comparisons with results for apples in other ripeness states than ours difficult (Woese et al. 1997), note this is not relevant for this study. The panellists were introduced to apple and fruit flavors using different reference samples, specifically, different varieties of apples at different levels of maturity, to elicit different attributes during training. This seemed to help the

<table>
<thead>
<tr>
<th>Attributes</th>
<th>Aroma Standard Cox Orange Elise Ingrid Marie Jonagold Royal Gala Rubinstar Red Aroma</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mean value</td>
<td>SD</td>
</tr>
<tr>
<td>Odor</td>
<td>Odor intensity, skin</td>
</tr>
<tr>
<td>Odor intensity, flesh</td>
<td>5.18</td>
</tr>
<tr>
<td>Citrus odor</td>
<td>2.42</td>
</tr>
<tr>
<td>Soil odor</td>
<td>1.71</td>
</tr>
<tr>
<td>Grassy odor</td>
<td>2.21</td>
</tr>
<tr>
<td>Texture</td>
<td>Juiciness</td>
</tr>
<tr>
<td>Tenderness</td>
<td>5.81</td>
</tr>
<tr>
<td>Crisp</td>
<td>4.46</td>
</tr>
<tr>
<td>Graininess</td>
<td>3.78</td>
</tr>
<tr>
<td>Firmness</td>
<td>3.54</td>
</tr>
<tr>
<td>Skin toughness</td>
<td>3.76</td>
</tr>
<tr>
<td>Basic taste</td>
<td>Sweet</td>
</tr>
<tr>
<td>Acidic</td>
<td>3.71</td>
</tr>
<tr>
<td>Bitter</td>
<td>1.45</td>
</tr>
<tr>
<td>Flavor</td>
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</tr>
<tr>
<td>Pear</td>
<td>2.67</td>
</tr>
<tr>
<td>Flavor intensity</td>
<td>5.01</td>
</tr>
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|SENSORY AND SEMANTIC LANGUAGE MODEL
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</thead>
<tbody>
<tr>
<td></td>
<td>Mean value</td>
<td>SD</td>
<td>Mean value</td>
<td>SD</td>
<td>Mean value</td>
<td>SD</td>
<td>Mean value</td>
<td>SD</td>
</tr>
<tr>
<td>Odor</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Odor intensity, skin</td>
<td>3.98</td>
<td>1.05</td>
<td>2.64</td>
<td>0.87</td>
<td>3.16</td>
<td>1.1</td>
<td>3.48</td>
<td>0.98</td>
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<td>Odor intensity, flesh</td>
<td>5.18</td>
<td>0.87</td>
<td>4.01</td>
<td>0.93</td>
<td>5.62</td>
<td>1.09</td>
<td>4.75</td>
<td>1.21</td>
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<tr>
<td>Citrus odor</td>
<td>2.42</td>
<td>0.83</td>
<td>2.03</td>
<td>0.8</td>
<td>2.53</td>
<td>1.09</td>
<td>2.56</td>
<td>1.04</td>
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<td>Soil odor</td>
<td>1.71</td>
<td>0.62</td>
<td>1.75</td>
<td>0.73</td>
<td>1.92</td>
<td>1.01</td>
<td>1.65</td>
<td>0.89</td>
</tr>
<tr>
<td>Grassy odor</td>
<td>2.21</td>
<td>0.59</td>
<td>1.94</td>
<td>0.55</td>
<td>1.96</td>
<td>0.81</td>
<td>2.01</td>
<td>0.68</td>
</tr>
<tr>
<td>Texture</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Juiciness</td>
<td>6.04</td>
<td>1.05</td>
<td>4.91</td>
<td>1.29</td>
<td>5.62</td>
<td>1.15</td>
<td>5.44</td>
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</tr>
<tr>
<td>Tenderness</td>
<td>5.81</td>
<td>1.25</td>
<td>4.88</td>
<td>1.54</td>
<td>3.34</td>
<td>1.21</td>
<td>4.52</td>
<td>1.15</td>
</tr>
<tr>
<td>Crisp</td>
<td>4.46</td>
<td>1.26</td>
<td>4.13</td>
<td>1.27</td>
<td>6.24</td>
<td>1.2</td>
<td>5.05</td>
<td>1.13</td>
</tr>
<tr>
<td>Graininess</td>
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<td>0.86</td>
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<tr>
<td>Firmness</td>
<td>3.54</td>
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<td>6.65</td>
<td>1.07</td>
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<tr>
<td>Skin toughness</td>
<td>3.76</td>
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<td>4.84</td>
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<td>4.24</td>
<td>0.93</td>
<td>4.81</td>
<td>1.21</td>
</tr>
<tr>
<td>Basic taste</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sweet</td>
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<td>4.73</td>
<td>1.09</td>
<td>4.52</td>
<td>1.34</td>
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<td>5.01</td>
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<td>1.66</td>
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<td>Bitter</td>
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<td>1.44</td>
<td>0.52</td>
<td>1.43</td>
<td>0.57</td>
<td>1.47</td>
<td>0.49</td>
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<tr>
<td>Flavor</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Astringent</td>
<td>1.61</td>
<td>0.45</td>
<td>1.88</td>
<td>0.6</td>
<td>2.02</td>
<td>0.66</td>
<td>1.94</td>
<td>0.71</td>
</tr>
<tr>
<td>Pear</td>
<td>2.67</td>
<td>1.31</td>
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panellists select the high- or low-intensity reference samples for the actual attributes of interest. A common design when eliciting vocabulary for a specific food product in the sensory sciences is first to find more universal attributes for the actual food group and with training define the vocabulary to be used in a descriptive analysis to profile a product according to all perceived sensory characteristics (Lawless and Heymann 1999).

An advantage of using descriptive analysis is that the panellists are selected, trained, and calibrated for a period before the assessment (Meilgaard et al. 2006). Moreover, some difficulties arose when the panel was extracting vocabulary and definitions, for example, “citrus fruit” as an attribute. To prevent any difficulties and misunderstandings, the panel was exposed to a wide range of products within the categories, to establish the definitions and intensities. However, a semantically anchored model enables systematic and lexical precision within sensory expression, and could serve as an expanded lexicon to show the domains from which the words arrive when extracting words during panel training. For example, when discussing and testing different reference samples to establish attributes and correct definitions, the model could be used as a set of guidelines for the panel and the panel leader (see Figs 5 and 6). Another function of such a model is that it may help make the training more specific and less time-consuming, while also eliciting more words. Colour is probably one of the simplest attributes of concept formation and definition. However, colour is also well known to the consumer purchasing apples. Colour attributes were therefore excluded before the actual survey.

**Assessment of Sensory Attributes of Apples Performed by the Consumers**

A PCA correlation loading plot was then made on the consumer data, 14 attributes and eight samples, with samples indicated as dummy variables; see Fig. 3, in which the inner circle represents 50% and the outer circle 100% of the explained variance within the circle. The data in the first principal component accounted for 49% of the explained variance along the axis running through the cloud containing most of the points; in other words, the first principal component accounted for the largest single portion of variance. Furthermore, the second principal component accounted for 24% of the explained variance, the second largest portion of variance.

An initial version of a PCA plot (figure not shown) was carried out with all the words used more than five times by the consumers, a total of 243 words; this illustrated the structure and closeness of the words. As the first step in the data treatment, the individual variables accounting for less than 50% of explained variance in a correlation plot were considered not relevant for the competent shown in figure.
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An advantage of using descriptive analysis is that the panellists are selected, trained, and calibrated for a period before the assessment (Meilgaard et al. 2006). Moreover, some difficulties arose when the panel was extracting vocabulary and definitions, for example, “citrus fruit” as an attribute. To prevent any difficulties and misunderstandings, the panel was exposed to a wide range of products within the categories, to establish the definitions and intensities. However, a semantically anchored model enables systematic and lexical precision within sensory expression, and could serve as an expanded lexicon to show the domains from which the words arrive when extracting words during panel training. For example, when discussing and testing different reference samples to establish attributes and correct definitions, the model could be used as a set of guidelines for the panel and the panel leader (see Figs 5 and 6). Another function of such a model is that it may help make the training more specific and less time-consuming, while also eliciting more words. Colour is probably one of the simplest attributes of concept formation and definition. However, colour is also well known to the consumer purchasing apples. Colour attributes were therefore excluded before the actual survey.

Assessment of Sensory Attributes of Apples Performed by the Consumers

A PCA correlation loading plot was then made on the consumer data, 14 attributes and eight samples, with samples indicated as dummy variables; see Fig. 3, in which the inner circle represents 50% and the outer circle 100% of the explained variance within the circle. The data in the first principal component accounted for 49% of the explained variance along the axis running through the cloud containing most of the points; in other words, the first principal component accounted for the largest single portion of variance. Furthermore, the second principal component accounted for 24% of the explained variance, the second largest portion of variance.

Next, each attribute in a PCA correlation plot was visually evaluated and all deviant variables (in relation to most of the respondents using the same attributes) were removed. Finally, based on the remaining variables, we calculated new averages; the data treatment procedure and results are shown in Table 3 and Figure 3. In Fig. 4, ELISE is seen to lie on the right-hand side along PC1; it was described by the consumers as having a high intensity of astringency, crisp, acidic taste, chewing toughness, skin toughness, sour taste, acidic odor and apple flavor. RED AROMA was positioned diagonally leftwards and down from ELISE, and was perceived as high in apple odor, acidic odor, astringency, acidity, sourness, apple flavor and crisp. Closer to the centre of the figure, INGRID MARIE was described by the consumers as having a relatively high intensity of firmness, chewing toughness, skin toughness, and astringency. JONAGOLD was positioned on the left side along PC1; this variety was characterized as being juicy and sweet in taste and odor, and was described the affective attribute of tasteful.

Figure 3 also reveals, along the lower part of PC2, that the consumers perceived RUBINSTAR and AROMA ST as quite similar, both having high levels of juiciness and apple odor. However, RUBINSTAR leaned toward the affective attribute of tasteful, while AROMA ST leaned toward the attribute of apple flavor. At the opposite, upper, end of PC2, ROYAL GALA and COX ORANGE were positioned quite close to each other, similar to the trained panel’s description, with neither a high nor a low intensity for any of the...
<table>
<thead>
<tr>
<th>Attributes in English</th>
<th>Attributes in Swedish</th>
<th>Number of observations</th>
<th>Number of variables &gt; 50 % explained variance in preliminary PCA correlation loading</th>
<th>Number of variables after visual evaluation in preliminary PCA correlation loading</th>
<th>Attributes &gt; 50 % explained variance in PCA and used in the PCA and PLSR</th>
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</thead>
<tbody>
<tr>
<td>Odor</td>
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<tr>
<td>Odor intensity</td>
<td>Doftintensitet</td>
<td>10</td>
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<tr>
<td>Sweet odor</td>
<td>Söt doft</td>
<td>8</td>
<td>7</td>
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</tr>
<tr>
<td>Apple odor</td>
<td>Äpple doft</td>
<td>11</td>
<td>7</td>
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<tr>
<td>Acidic odor</td>
<td>Syrlig doft</td>
<td>8</td>
<td>5</td>
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<td>Texture</td>
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<td>Juiciness</td>
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<td>Grynhighet</td>
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<td>Tuggmotstånd</td>
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<tr>
<td>Skin toughness</td>
<td>Tuggmotstånd skal</td>
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<td>Basic taste</td>
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<td>21</td>
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<tr>
<td>Sweet</td>
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<td>Besk</td>
<td>6</td>
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<td>Flavor</td>
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<td>Astringent</td>
<td>Strävhet</td>
<td>6</td>
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<td>Äppelsmak</td>
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<td>Flavor intensity</td>
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<td>Affective</td>
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PCA, principal component analysis; PLSR, partial-least squares regression.
attributes along PC2 except for firmness and a touch of sweet taste and odor. The words used more than five times by the consumers differ slightly from those obtained using RGM analysis by Andani et al. (2001) when investigating three dessert apples, for example, the consumers used attributes such as soft, cooking apple, tasteless, coarse, dry and spongy.

The RGM was used in the one-to-one interviews in which the consumers were asked to describe the sensory quality of the product (Kelly 1955; Gains 1994; Fransella et al. 2003). The use of RGM when investigating consumer perceptions of apples generates less technical descriptions than those of a trained sensory panel, and the consumers are able to use their own words to describe the apples’ attributes. For example, in this case, the consumers used words related to their memory and experience, such as summer apple taste or dishrag odor. Texture and taste terms were generally quite similar between the groups, whereas odor posed more problems as it is was more difficult to verbalize.

Some of the consumers initially experienced some difficulties eliciting words for the first triad, but by the time the second triad was offered, they seemed to have developed confidence and were able to use more words to express themselves. The triad method helped the consumers generate a sufficient number of attributes.

Table 2 and Fig. 3 show that mainly cognitive words were used to describe apples, except for one affective attribute, tasteful. In general, during the first part of the interview, the consumer often used affective attributes when discussing the sensory quality of the apples. This seemed to help the consumers in the process of eliciting more descriptive attributes. For example, Table 3 indicates a high coherence for the descriptive attributes juiciness, acidic and sweet. Another observation from Fig. 3 is that the affective attribute tasteful relates, to a certain extent, to sweet taste, sweet odor and juiciness, at the same time negatively correlated to chewing toughness. Daillant-spineller et al. (1996), for example, found in their survey that consumers preferred sweet, juicy, and acidic apples. Similar values were reported by Kajikawa (1998), who, when studying wholesale prices in Japan, found that apples should not be too tart (high acidic, low sugar) or too sweet (high sugar, low acidic). For example, Fig. 3 shows that JONAGOLD was perceived as possessing a high intensity of juiciness, sweet taste and sweet odor while scoring relatively low for acidic taste. JONAGOLD was also perceived as tasteful by the consumers; however, the main objective of this study was to generate words, and not all consumers used the affective attribute tasteful, but it could give some hints. For example, the closeness between tasteful, juicy, and sweet in Fig. 3. However, the frequency levels of attributes were gradually reduced during data treatment. For example, the frequency of juiciness was reduced by 44%. Attributes such as tasteful, apple flavor and astringent were reduced to below 5 (see Table 3).
From a methodological point of view, Chang et al. (2009) suggested that a way to enlarge the number of attributes for the data analysis would be to increase the number of consumers/interviews or to work with more than just one consumer at a time in group sessions. In this case, it may be a suitable way to create appealing language for describing fruit and vegetables for the marketing purposes of industrial companies. The disadvantage of RGM is that it is quite time-consuming, considering the triad procedure and the one-to-one interviews. A similar method, free choice profile (FCP), does not include the triad procedure but allows panellists the same freedom to elicit and assess their own attributes. Another interesting observation during the interviews was that the consumers, generally had preconceptions about their favourite apple varieties before the interviews started. However, they seemed to change their perceptions during the interviews. The triad method was of great help; that this method could be used in a simplified form in retail stores, or market different apple varieties to consumers.

Comparison of Assessment of Sensory Attributes Performed by the Trained Panel and Consumers

We also compared the vocabularies used by the trained panel and by the consumers, presented above, to find out whether the two groups used similar descriptors for the sensory attributes. The explained variance from the PLSR was accounted for by the X variables (58% and 25%) and the Y variables (40% and 23%; see Fig. 4).

Figure 4 also reveals a correlation between acidic taste as used by the trained panel and the consumers; acid and sour are synonyms, but the consumers used the Swedish words syrlig and sur, which are translated as acidic and sour in English. It should be noted that only six consumers used the attribute sour while 31 used acidic, see Table 3. Four of the consumers using the attribute sour also used acidic at the same time, and the consumers perceived sour and acidic at slightly different intensities between the samples. Flavor intensity as used by the trained panel was localized and correlated positively with apple flavor as used by the consumers. On the left side along PC1, sweet taste and pear flavor perceived by the trained panel were correlated with sweet taste and sweet odor used by the consumers. Juiciness as used by the trained panel and by the consumers correlated positively along the upper part of PC2. Tasteful as used by the consumers correlated positively with juiciness, pear odor, pear flavor, tenderness, sweetness, and graininess as used by the trained panel. JONAGOLD and AROMA ST could be regarded as apples with a good balance between acidity, sweetness, and juiciness, considering that the affective attribute of tasteful was localized quite close to these apples in Fig. 4.
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Figure 4 reveals a correlation on the right-hand side of the figure between the trained panel and the consumers within for the attribute groups of odor, texture, taste and flavor. Furthermore, the citrus odor and flesh odor attributes used by the trained panel correlated with acidic odor and apple odor used by the consumers, positioned in the upper right of the figure. Crisp and firmness as used by the trained panel correlated positively with crisp, firmness, chewing toughness and skin toughness used by the consumers along PC1. Skin toughness as used by the trained panel was positioned at the lower end of PC2, fairly near firmness, skin toughness and chewing toughness as used by the consumers. The trained panel perceived a greater difference between skin toughness and firmness than did the consumers. Furthermore, astringency as used by the trained panel and the consumers correlated positively along the right-hand side of PC1.

As shown in Fig. 4, the perceptions of the consumers were quite similar to those of the trained panel, and they often used the same words to describe the texture, taste and flavor of the samples. Attributes that were close together on the plot were interpreted as being perceived as quite similar, while the attributes that were close to a given sample indicated the sensory characteristics of that sample. Previous studies comparing the perceptions of trained panels and of consumers have obtained similar results from both groups (Andini et al. 2001; Fillion and Kilcast 2001; Hersleth et al. 2005). However,
it was important to establish that this was also the case for eight specific varieties of apples in Sweden.

In addition, according to Daillant-spinnler et al. (1996), consumer preferences in apples are based on the balance between taste and texture. However, Daillant-spinnler et al. (1996) also found that consumer preferences could be divided into two groups: (1) preference for a firm and sweet apple, versus (2) preference for a juicy and acidic one. In this study, we found two sets of apples with opposite descriptions: ELISE was firm and acidic, while JONAGOLD and AROMA ST were juicy and sweet. According to Jaeger et al. (1998), both British and Danish consumers reported flavor and texture as the two characteristics that were most important in determining apple choice, surpassing other sensory qualities; the present study shows that the trained panel and consumers also regarded these attributes as the most important ones.

The results presented here are based on eight varieties of apples available at a specific time of year in Sweden. Considering the effects of harvest period and storage conditions, it may be difficult to compare the present results with those for apples in other states of ripeness (Woese et al. 1997). For this reason, the consumer investigation was held in conjunction with the trained panel assessment, to prevent as far as possible any erroneous differences between the apple varieties. The consumer perceptions were quite similar to those of the trained panel, and similar values have been reported by Hersleth et al. (2005), Fillion and Kilcast (2001) and Andini et al. (2001) in previous studies comparing sensory panels with consumers. In addition, the trained panel’s sensory vocabulary revealed, not entirely surprisingly, that they could describe the apple samples in greater detail than could the consumers, as was also reported by Andini et al. (2001). It is important to consider the choice of words in a marketing situation when communicating the sensory attributes to consumers, so using the attributes and vocabulary mainly used by the consumers may minimize problems of consumer misunderstanding. In the present case, however, the consumers and trained panel used quite similar attributes. (Note that we only used words occurring more than five times by the consumers).

The two panels used many identical words when describing apple texture and taste. Note that trained panel explained a total of 83% of the variation (Fig. 3) between the apples using 15 attributes, while the consumers explained a total of 73% of the variation (Fig. 3) using 14 attributes. This result was not that surprising in light of the results of similar investigations of bread (Hersleth et al. 2005) and apples (Gómez et al. 1998), where the perceptions and vocabulary of consumers and trained panels were quite similar. Attributes generated by the trained panel were discussed and agreed on in the panel, while the consumers individually generated their own attributes. The aim of our study was not to develop a lexicon for apples of sensory description but to develop a sensory description based on perception of newly trained student
panel compared to Hersleth et al. (2005), who used a highly trained panel. Anyhow her result was in accordance with ours in spite of that.

Combining sensory data with a method based on semantic frame theory could offer an important way to extract valuable words with which to develop a sensory semantic frame for future product descriptions. The absence of appearance terms from the consumers’ and trained panel’s vocabularies were because of the fact that they only had been asked for flavor and texture attributes.

Outline of a Sensory Semantic Frame for Apples

Sensory semantic frames for apple will differ in extension depending on their foundations; see Fig. 7 for a general (e.g., not based on a specific corpus or apple type) sensory semantic frame for apple. Figure 6 shows a sensory semantic frame based on the words in Tables 1 and 3, that is, the lexical outcome of both the trained panel and the consumers. The points of departure for the frame design are Barsalou (1992) and, for the sense categories, Meilgaard et al. (2006).

The fact that the original vocabulary is in Swedish makes some reflections necessary. There is no guarantee of total semantic agreement between a word pair in two different languages. The semantics of crispness and crisp can be taken as an example to highlight the lexical difference between languages, in this case, Swedish and English. Here, the Swedish words krispig and krispighet have been translated into the English words crisp and crispness. According to Webster Dictionary, W. s. O. (2009), the English word crisp (the semantic base of crispness) means (1) “tender and brittle,” a definition that would also include objects with a crisp surface but a soft core, such as waffles or Danish pastries; and (2) “pleasingly firm and fresh and making a crunching noise when chewed”; suitable objects here would be a slice of raw onion, a thin almond biscuit, or a piece of iceberg lettuce. However, in Swedish, there are two different words to capture these two different meanings: frasig (1) and krispig (2). Figure 5 shows this semantic difference in semantic frame form. Because of such lexical discrepancies, the categorization of words could vary; in Swedish, krispig/krispighet would belong to a “firmness” group, because all objects described with krispig would be firm. Other cases are less complicated: Swedish citrus and päron correspond both stylistically and semantically to English citrus and pear. To sum up, from a semantic–conceptual point of view, the English vocabulary presented here should be very close to the semantic content of the corresponding original Swedish words, though a complete conceptual agreement would not be possible.

Figure 6 is based on the categorization in Tables 1 and 3; that is, all the flavor words in Fig. 7 are found under “Flavor” in these tables. Words occur-
ring fewer than five times have been excluded from the frame, but could easily be used in an expanded sensory semantic frame (see Fig. 7). Some such odor and flavor words are *vanilla, flower, nectarine, pineapple, sugar peas* and *white currants*. In a taxonomically expanded sensory semantic frame, such
words would have superordinates denoting the semantic domains of the words, for example, VEGETables for sugar peas and BERRIES for white currants.

The dominant cognitive system for identification and retention of odors seems to be subserved by the right cerebral hemisphere and the linguistic processes by the left which, makes a weak connection between the linguistic and olfactory processes in the brain as described in a review by Richardson and Zucco (Richardson and Zucco 1989). Use of verbal elaboration – semantic frame and semantic domain analysis combined with taxonomic semantics – can lead to enhanced recognition and memory for odors as done during training of the panel members and using repertory grid method for consumers (Cruse 1986). The word astringent seems oriented toward touch rather than gustation, but here too, the frame follows the actual categorization in Tables 1 and 3. The words describing texture dimensions form two groups, which, using the terminology of Meilgaard, may be described as “mechanical properties” and “geometrical properties” (Meilgaard et al. 2006). The former group is oriented toward stress reaction and is measured kinesthetically, while the latter is measured tactiley and also seems to have a component of vision, e.g., “perception of particles (size, shape, orientation)” (Meilgaard et al. 2006). Words belonging to the former group are tenderness, crispness, firmness and toughness (e.g., skin and flesh toughness). When constructing a larger and more detailed sensory semantic frame, while following Meilgaard et al. (2006), this group could be subcategorized into the conceptual domains of “hardness” (tenderness, firmness) and “cohesiveness” (crispness, toughness). The limits are not always clear; however, crispness is concerned not only with cohesiveness, but also with hardness, because something crisp would usually also be hard. Graininess is the only member of the geometrical group here, and is taken to mean “consisting of rather small and soft particles,” or, following Webster Dictionary, W. s. O. (2009), having “the quality of being composed of relatively large particles” a definition that likely means it is possible to perceive the particles visually.

Figure 7 presents an excerpt from a sensory semantic frame for apple (e.g., no specific apple type). The lower parts of Fig. 7 show possible attributes for apple for each box above. Most, but not all, of these words are found in the material gathered from the trained panel and the consumers; the main purpose of Fig. 7 is not to represent only the trained panel’s and the consumers’ vocabulary, but to illustrate how a more expanded semantic frame could look like. Some of the values are prototypical (e.g., actualized by and relevant to most people), for example, “red” and “sweet”, while others are less common, for example, “buckled” and “melon” (Rosch and Mervis 1975). A more complete semantic frame for apple would include also non-sensory attributes, such as ORIGIN, USE, STORING, PRICE, HARVEST and TIME. Such an
expanded frame represents a complex system of relationships at different levels within the frame, for example, could the attribute ORIGIN be subdivided into GEOPGRAPHICAL, AGE (of species) and CULTIVATOR.

A semantic frame can be used in different ways and for different purposes: as a point of departure when starting to describe a certain item in a marketing context, as a way of sorting words in a given word corpus (e.g., a more or less extensive gathering of words excerpted from different texts), and so on. An important point when using semantic frames as a basis – regardless of the aim – is that most aspects of the product in question are likely to be elucidated; in addition, they encourage and enable lexical expansion when lexical gaps within different semantic domains are shown. The lexical establishment of superordinates such as VEGETables and BERRIES would be a fruitful point of departure when expanding the sensory description for a certain item, since they evoke co-hyponymes to (for example) white currant such as black currant as well as words denoting other berry species such as raspberry, blueberry and so on.

As discussed above, the cerebral connections between the linguistic and olfactory processes seem to be weak, and the use of semantic frames in combination with semantic domain analysis and taxonomic semantics could enhance odor recognition and memory in training of the panel members and when using repertory grid method (Cruse 1986; Richardson and Zucco 1989).

**CONCLUSION**

In accordance with previous works comparing consumers’ and trained panels’ perceptions of apples and various food products, the two groups’ perceived results were similar (Gómez et al. 1998; Andini et al. 2001; Fillion and Kilcast 2001; Hersleth et al. 2005). In this case, the two groups, consumers and a newly trained student panel also perceived red apples in quite similar terms. PLSR revealed that the words used by the consumers correlated quite well with the terminology used by the trained panel, and that texture, taste, and flavor attributes were among the key attributes describing the apples’ sensory qualities. Odor was found to be less useful; the trained sensory panel used attributes related to skin, flesh, citrus, soil and grass while the consumers used sensory attributes such as odor intensity, sweetness, “appleness” and acidity. This combination of sensory data with semantic frame theory enables the creation of a structure of words, which in turn allows the derivation of the conceptual content contained by a certain word.

From a linguistic point of view, it is interesting to survey semantic patterns (above all, the conceptual components shown in a semantic frame) of the apple descriptors in general, as well as words describing different species.
of apples. Semantic frame analysis could also explain how words differ in meaning, to arrive at the optimal word to capture a certain aspect of an item. An example of this is shown in Fig. 7, where the heterogeneous semantics of Swedish krispig and frasig (English crisp) are shown. Furthermore, an expanded semantic analysis including lexical and taxonomic semantics could suggest different ways of expanding the sensory descriptors. The study showed that the sensory and semantic language model used could be important for the future development of sensory product descriptions, for use in contexts such as marketing in retail stores, to communicate the sensory properties of apples to consumers.

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1. Introduction

How do we communicate a sensory experience of food? For example, we most probably would describe the sensory experience of a food product as "It was good, I liked it", but would probably not be able to describe the sensory characteristics of the various products with some precision. It seems that sensory aspects vary in how difficult they are to express verbally (Engen 1991); we do not use the same degree of precision of taste, smell and texture as we do to vision (Meilgaard et al. 2006). It has been argued that perceptual descriptions of colours and odours are based on different organizational principles (Richardson and Zucco 1989). Colours seem to involve a lexical system that is organized in memory, while odour perception is characterized by flexibility and adaptability but with a nonverbal coding system (Engen 1987). About 400,000 odorous substances exist, and it is not clear how many of these are similar or how many classes there might be (Engen 1982). Thus, to characterize the perceived odour and flavour (in which odour is involved) is a complex task (Amerine et al. 1965). The human being is equipped with mechanisms that could guarantee that we, to some extent, perceive the same thing with our "higher" senses, vision and audition. But the "lower" senses in the oro-nasal cavity do not function with the same accuracy when it comes to how we perceive things – they rely more on learning, memories and experiences (Köster 2003). Other circumstances such as gender and age could of course also affect the ability to detect and identify different sensory properties (Richardson and Zucco 1989). Without a description of the sensory qualities, the individual profiles of the item in question could not be captured.

From a linguistic point of view, sensory studies seem to include many aspects highly relevant to different linguistic areas. Since sensory descriptions of food mainly operate with words, such as crisp, tender and nutty, including their conceptual content, lexical and cognitive semantics seem to be a fruitful approach to studying and developing sensory descriptions. But in spite of the central role of the lexicon in describing sensory qualities of food, surprisingly little attention has been paid to linguistic aspects of sensory language, which may be due to the fact that sensory studies and linguistics belong to different academic disciplines. Briefly, in sensory studies, some guidelines are usually used for words and definitions, e.g. the ISO standard and ASTM (American Society for Testing and Materials) Noble et al. (1987) created a system for aromatic flavour for wine arranged in a partly taxonomic and semantic domain-based wheel, i.e. rather general semantic domains such as "fruity" and "nutty". The specific-general dimension in the wheel is obvious; the general "fruity" leads to the more specific "berry" and "strawberry" in the outer tier of the wheel. More recently Pickering and Demiglio (2008) used the same model for a white wine's mouthfeel. There are a large number of studies where sensory vocabularies are discussed and developed; some recent examples are Duffrin and Pomper (2006), Carunchia Whetstine et al. (2007), Hongsoongnern and Chambers (2008) and Civille et al. (2010) regarding pawpaw fruit puree, Cheddar cheese, tomatoes and almonds respectively. However inspiring and important in sensory studies and marketing, DOI: 10.1080/00393274.2011.603905
Green Frames: A Semantic Study in the Lexicon of Babyleaf Salad

ULF LARSSON AND JOHAN SWAHN

1. Introduction

How do we communicate a sensory experience of food? For example, we most probably would describe the sensory experience of a food product as “It was good, I liked it”, but would probably not be able to describe the sensory characteristics of the various products with some precision. It seems that sensory aspects vary in how difficult they are to express verbally (Engen 1991); we do not use the same degree of precision of taste, smell and texture as we do to vision (Meilgaard et al. 2006). It has been argued that perceptual descriptions of colours and odours are based on different organizational principles (Richardson and Zucco 1989). Colours seem to involve a lexical system that is organized in memory, while odour perception is characterized by flexibility and adaptability but with a nonverbal coding system (Engen 1987). About 400,000 odorous substances exist, and it is not clear how many of these are similar or how many classes there might be (Engen 1982). Thus, to characterize the perceived odour and flavour (in which odour is involved) is a complex task (Amerine et al. 1965). The human being is equipped with mechanisms that could guarantee that we, to some extent, perceive the same thing with our “higher” senses, vision and audition. But the “lower” senses in the oro-nasal cavity do not function with the same accuracy when it comes to how we perceive things – they rely more on learning, memories and experiences (Köster 2003). Other circumstances such as gender and age could of course also affect the ability to detect and identify different sensory properties (Richardson and Zucco 1989). Without a description of the sensory qualities, the individual profiles of the item in question could not be captured.

From a linguistic point of view, sensory studies seem to include many aspects highly relevant to different linguistic areas. Since sensory descriptions of food mainly operate with words, such as crisp, tender and nutty, including their conceptual content, lexical and cognitive semantics seem to be a fruitful approach to studying and developing sensory descriptions. But in spite of the central role of the lexicon in describing sensory qualities of food, surprisingly little attention has been paid to linguistic aspects of sensory language, which may be due to the fact that sensory studies and linguistics belong to different academic disciplines. Briefly, in sensory studies, some guidelines are usually used for words and definitions, e.g. the ISO standard and ASTM (American Society for Testing and Materials) Noble et al. (1987) created a system for aromatic flavour for wine arranged in a partly taxonomic and semantic domain-based wheel, i.e. rather general semantic domains such as “fruity” and “nutty”. The specific-general dimension in the wheel is obvious; the general “fruity” leads to the more specific “berry” and “strawberry” in the outer tier of the wheel. More recently Pickering and Demiglio (2008) used the same model for a white wine’s mouthfeel. There are a large number of studies where sensory vocabularies are discussed and developed; some recent examples are Duffrin and Pomper (2006), Carunchia Whetstine et al. (2007), Hongsoongnern and Chambers (2008) and Civille et al. (2010) regarding pawpaw fruit puree, Cheddar cheese, tomatoes and almonds respectively. However inspiring and important in sensory studies and marketing,
these works are not always very systematic from a linguistic point of view. Several of the studies mentioned above use a wheel model to categorize the sensory descriptors, but as may be seen in for example Duffrin and Pomper (2006), the wheel form can make the semantic subcategorization tricky; in this “pawpaw fruit puree sensory wheel”, the words are not categorized at all except their grouping into different sensory dimensions such as texture, flavour etc. Besides, the wheel form seems to be best suited for one sensory dimension at a time, as may be seen in for example the wine aroma wheel of Noble et al. (1987). In this wheel, though, the word groups are sometimes a bit fuzzy semantically; for example, olives, asparagus and green beans are grouped together as a subcategory of “canned/cooked”, and the taxonomies are often asymmetrical in that the same word is sometimes used on several levels (for example “nutty” and “floral”, which both occupy two levels in the wheel), while the corresponding levels in other sectors show specification (“fruity” and on the next level “tropical fruit”). It may be assumed that a cross-disciplinary meeting between sensory studies and linguistics could provide interesting views leading to expanded awareness of the importance of semantics in the future development of different sensory vocabularies, as shown in a study by Swahn et al. (2010).

1.1 Sensory Science for Food in General

Sensory science has been defined as a scientific method used to “evoke, measure, analyze, and interpret those responses to products as perceived through senses of sight, smell, touch, taste and hearing” (Stone and Sidel 2004: 13). In sensory science, consumers are used as instruments and sometimes trained to use the same terms when evaluating food products objectively by the senses (Lawless and Heymann 1999). We usually perceive food in the order of (1) appearance, (2) odour/aroma/fragrance, (3) consistency and texture and (4) flavour (aromatics, chemical feelings, taste), with some overlap among the groups (Meilgaard et al. 2006). One problem could be that the vocabularies that are used do not correlate with each other. For instance, hardness and denseness might be confused (Civille and Lawless 1986). We are often able to recognize a taste or odour as being familiar but without addressing the correct label of the sensory property (Engen and Ross 1973). This annoying gap was once called “tip of the nose” or “on the tip of the tongue” (Lawless and Engen 1977: 57). An example is cabbage-like and skunky for natural compounds, e.g. organic sulphur (Cairncross and Sjöström 1950). The use of multiple reference standards for a single item such as apple enhances learning and use of the item in question (Ishii and O’Mahony 1991), e.g. as a designation of sweetness, a sucrose solution could be presented in a way to perceive different intensities of sweetness (Rainey 1986). Moreover, other sets of attributes perceived by sensors in the mouth would be quite complex, as is demonstrated by the mere existence of the Journal of Texture Studies.

The human senses and their function and interaction within and among the sensory modalities considering sensory testing are well covered in textbooks, e.g. Lawless and Heymann (1999) and Meilgaard et al. (2006). What we could conclude is that a lot of receptors generate different signals from the perception that they send to the brain, and a delicate task is here to express the perception in words. A combination between sensory data and semantic frame theory was presented by Swahn et al. (2010), which enabled the creation of a structure of words, which in turn allows the derivation of the conceptual content contained by a certain word. A similar subcategorization into different conceptual domains is also sketched by Meilgaard et al. (2006).

1.2 The Semantic Frame Approach

A semantic frame could be defined as a description and representation of how the mental lexicon is structured and organized in long-term memory and working memory and how
different sensations and experiences of the outer world are linked to words (Barsalou 1992; Barsalou et al. 1993). The central idea of semantic frame theory is that words, or rather the concepts and conceptualizations beyond the words, are represented in the mental lexicon as a kind of network consisting of a root or trigger concept that is framed or surrounded by other concepts. For some theoretical discussions and applications of semantic frame theory, see e.g. Fillmore and Atkins (1992), Fillmore et al. 2010), Barsalou (1992; Barsalou et al. 1993), Persson (2000) and Larsson (2004). The definition of concept in this paper follows Barsalou et al. (1993) where “concepts are bodies of knowledge in long-term memory” and “[c]oncepts are the underlying knowledge in long-term memory from which temporary conceptualizations in working memory are constructed” (1993: 57). Thus, a certain concept – evoked in the mind by a word, a scent, a picture or something else – seems always to comprise and evoke other concepts without which it cannot be understood at all. Some of these other concepts are canonical, i.e. necessary in order to understand the first concept, such as hand for finger or dead for murder (Cruse 1986: 157ff.). Besides such canonical concepts, a certain concept also has more or less prototypical concepts inherently, i.e. concepts most likely to be evoked by most people and mentioned in dictionary definitions, where the reference would be more generic than individual. As discussed by Barsalou et al., in concrete situations with individuals as referents, a concept – which in itself is likely to be locally flavoured since most people do not include the total extension of a category – is mixed up with the actual referent to make up the meaning (1993: 48ff.). An example of such a conceptualization – a reference going from generic to individual – would be the meaning of the word red, which differs depending on the frame comprising it (apple, brick, hair, wine, fire truck). Here, very different red colours are evoked. Thus, concepts may be said to be partly fuzzy, partly context dependent – and highly recursive conglomerates of other concepts. When saying that a certain vegetable is green, coarse in texture, has an odour of cabbage and a nutty flavour, we communicate a lot more than what the lexical surface reveals.

In the model of semantic frame theory that we use in our analysis, Barsalou describes the cobweb that makes up a concept in terms of attributes and their values (1992). A certain concept, in Barsalou’s frame model called “root node” (in Barsalou [1992], always referred to by a single lexical unit such as vacation) has a number of attributes that are to some degree context dependent. An attribute in this sense is to be understood as a kind of empty slot, which may assume different values for different examples of the category on a scale going from canonical via prototypical to facultative and, finally, impossible or at least very idiosyncratic. For vacation, some canonical concepts (or attributes) would be ACTIVITY, LOCATION and DEPARTURE, as suggested by Barsalou (1992: 60). These attributes can have prototypical and plausible values such as skiing, beach, summer or less expected ones such as working, stairs or none. What attributes different concepts have or may have differs of course for various ontological and contextual reasons. For example, physical objects have sense-related attributes such as FORM, COLOUR, SMELL, WEIGHT and the like. Almost all physical objects whatsoever seem to have the attributes PART and TYPE (PART corresponds to the holonym within the lexical relation of meronymy, e.g. skin is a holonym/value to the attribute PART of the meronym apple, while TYPE means a hyponym, e.g. Elise for apple [see Aitchison (1994: 97ff.) and Cruse (1986: 157ff.) for discussion of the lexical relation of meronymy; see also Chaffin (1992) for a thorough discussion of the complex concept of PART]). At the same time, people who are highly educated or skilled in a certain area are more likely to formulate relevant attributes and values for a certain category belonging to that area than people who are not. Semantic frames are highly recursive; every attributive value within a frame can be given its own attributes, in a theoretically endless chain.
1.3 The Purpose of the Study

The aim of this study is to analyse a sensory vocabulary for salads by using a semantic frame model. The analysis aims at highlighting different semantic aspects of the vocabulary, such as the inherent conceptual patterns of the words, their semantic domains and the specific–general dimension. A further purpose involved in this is to get an idea of how semantic frame analysis could be used to expand and develop sensory vocabularies in general.

2. Method and Material

2.1 Salad Types and Attributes

The nine salad species studied were the following: rucola, mâche, red mangold, bulls-blad, teen spinach, baby spinach, green roman, tatsoi and mustard. Since the results were aimed at providing a basis for sensory descriptions and marketing towards retail consumers, the sensory descriptive analysis did not consider different aspects of the sensory attribute VISION (size, colour, shape etc.), since these aspects are relatively obvious to the consumer in the commercial situation. Neither was the attribute HEARING studied; thus, the analysis focused on (different aspects of) the attributes TOUCH, OLFACTION and GUSTATION. The attribute TOUCH is divided into the three subcategories Texture: Mechanical, Texture: Geometrical and Moisture. The attribute OLFACTION consists of the single Odour, while GUSTATION is divided into Basic Taste and Flavour (see Meilgaard et al. 2006).

A sensory descriptive analysis was conducted of nine different species of small salad leaves (also called babyleaves) commonly found in grocery retail shops in Sweden. Thus, the result of the study is particularly applicable to salad available on the Swedish market. The salads may vary in sensory qualities depending on harvest period, storage, ripeness, country and season (Woese 1997).

2.2 The Vocabulary Development

2.2.1 Trained Consumers

A sensory vocabulary was discussed, developed and agreed on by 12 trained consumers, a sensory panel, led by a sensory panel leader. The panel was trained and calibrated for a total of 12 training sessions over a three-week period. In the first step of the training phase, the panel leader did provide the panel with various products to enable brainstorming of different kinds of attributes by taste samples. In the second step, the panel was trained by the panel leader to use a common reference frame trying to define the product descriptors and their intensity as a homogenous panel in order to find and establish the accurate terms (descriptors) for the products, including definitions (see Table 1). In the third step, the panel evaluated these descriptors and their intensity, ranging from low (1) to high (9). This method is very common within sensory science and is described in detail in Swahn et al. (2010). The number of descriptors decreased during the panel training, because of the need for overall agreement and definition for each descriptor.

2.2.2 Consumers

Thirty consumers were recruited in a grocery retail shop (ICA in Sweden), and the repertory grid method (RGM) was used to elicit words. This method involves three parts during one-to-one interviews: firstly a warm-up session in which we discussed the products in
2.2 The Vocabulary Development

The salads may vary in sensory qualities depending on harvest period, storage, ripeness, and their intensity as a homogenous panel in order to find and establish the accurate terms for overall agreement and definition for each descriptor. In the third step, the consumers evaluated the intensity of each product for each description (Gains 1994; Fransella et al. 2003). For more details see Swahn et al. (2010). As is shown in Table 2 and according to the RGM, the consumers were not asked to formulate definitions of the descriptors, which distinguishes the vocabulary from that of the trained panel in Table 1.

2.3 The Semantic Analysis

The semantic analysis performed could be described in the following concentrated form in four steps: (1) Tables 1 and 2 were presented in separate sensory semantic frames where the attributes TOUCH and GUSTATION were specified in different subcategories in the frames. (2) The words from Tables 1 and 2 and the corresponding semantic frames were to some extent grouped into different semantic domains in the form of semantic frames. (3) Sensory semantic frames for all the nine salad types were established, based on the vocabularies from the trained panel and the consumers. (4) Recursive semantic frames for some of the concepts within the frames for the nine salad types were established considering the attributes VISION: Colour and TYPE.

| Table 1. Sensory attributes used by the trained sensory panel (English and Swedish) with definitions developed for the evaluation of 9 salad varieties |
|---|---|---|
| Attributes in English | Attributes in Swedish | Definitions |
| **Odour** | **Doft** |  |
| Odour intensity | Odour intensity | Intensity of the sum of all odours |
| **Texture** | **Textur** |  |
| Crisp | Krispig | How crisp the salad seems during chewing |
| Firmness | Fasthet | The force required to bite through the salad sample |
| Juiciness | S臾ighet | Amount of juice from the first bite |
| Tender | M么 | The force needed to masticate the salad ready for swallowing |
| **Flavour** | **Smak** |  |
| Nutty | Nョligt | Flavour intensity of nuts like almond |
| Grass | Grョs | Flavour associated with green grass |
| Earthy | Jordig | Flavour associated with earth |
| Pepper | Pepprig | Flavour and heat intensity of pepper |
| Fatty | Fet | Flavour of fatty characteristics of oil and unsalted butter |
| Cabbage | Kョl | Flavour associated with white cabbage |
| Horseradish | Pepparrot | Flavour associated with horseradish |
| Flavour intensity | Smakintensitet | Intensity of the sum of all flavours |
| **Taste** | **Smak** |  |
| Bitter | B么tten | One of the basic tastes, e.g. quinine |
| Sweet | S么tta | One of the basic tastes, e.g. sucrose |
| Acidic | Syrlighet | One of the basic tastes, e.g. citric acid |
| Salt | S么ta | One of the basic tastes, e.g. salt |
| Umami | Umami | One of the basic tastes, e.g. monosodium glutamate (MSG). |


Table 2. Sensory attributes used by the 30 consumers with number of observations for each attribute

<table>
<thead>
<tr>
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<td>Kripsig</td>
<td>27</td>
<td>Flavour intens.</td>
<td>Jordig</td>
<td>19</td>
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<td>Gräs</td>
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<td>Chew, toughness</td>
<td>Tuggmotstånd</td>
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<td>Earthy</td>
<td>Jordig</td>
<td>17</td>
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<td>Fräscht</td>
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<td>Toughness</td>
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<td>Torr</td>
<td>5</td>
<td>After taste</td>
<td>Eftersmak</td>
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<td>Juicy</td>
<td>Såftig</td>
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<td>Cabbage</td>
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<td>Nöttig</td>
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### Table 2. Sensory attributes used by the 30 consumers with number of observations for each attribute

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<tr>
<th>English</th>
<th>Swedish</th>
<th>Nr of observ.</th>
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<td>Texture</td>
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<td>Blade</td>
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In this paper, we will show the complete outcome of the two first points. Regarding the third point, we will present sensory semantic frames for four salad types rather different in sensory aspects: ruccola, red mangold, mâche and mustard. These frames are based on the vocabularies used by the trained panel and the consumers respectively (Table 1 and 2). The words in the frames all occurred five times or more, with some exceptions from the consumers’ vocabulary, where the selection to some extent was qualitative. The fourth point will be exemplified with some of the frames semantically inherent in the four salad frames mentioned above.

Regarding the attributes and their subcategories, some comments may be of importance. Following Meilgaard et al. (2006: 11ff.), the attribute TOUCH was divided into Mechanical, Geometrical and Moisture. The Mechanical dimension is oriented towards stress reaction and is “measured kinaesthetically”, while the Geometrical dimension is measured tactilely and also seems to have a component of vision, i.e. “perception of particles (size, shape, orientation) measured by tactile means” (Meilgaard et al. 2006: 11). If one were to construct an even more detailed sensory semantic frame, following Meilgaard et al. (2006), this group could be subcategorized into hardness, cohesiveness, adhesiveness, denseness and springiness. But the limits are not always clear: the cohesive-fracturable examples crispy/crunchy are concerned not only with cohesiveness, but also with hardness, since something crisp would usually also be hard. The Moisture dimension, finally, has to do with the amount of juice in the food item in question, or in the words of Meilgaard et al., “perception of water, oil fat, measured by tactile means” (2006: 11). In line with Meilgaard et al. (2006) and sensory science in general, the attribute GUSTATION was also divided into the two subcategories, Basic Taste and Flavour, where the first category does not involve olfaction, while the second does.

3. Result and Discussion

The result and discussion section is presented in four steps (see 2.3). It begins with two semantic frames comprising the vocabulary of the trained panel and the consumers respectively (1). With these as a point of departure, we will discuss the Texture: mechanical, Texture: geometrical and Moisture lexicon, the Odour lexicon and finally the Basic Taste and Flavour lexicons (the attributes TOUCH, OLFACTION and GUSTATION respectively) (2). Thereafter, sensory semantic frames for four salad types will be presented (3). Then, recursive semantic frames for some of the concepts within the frames will be presented (4).

3.1 The Vocabularies Presented in Semantic Frames

The babyleaf vocabulary of the trained panel and the consumers could be transposed into two separate semantic frames as shown in Figures 1 and 2.

3.1.1 Texture lexicon

Not surprisingly, the vocabulary of the consumers shows more lexical variation, except Basic Taste where the five attributional values are identical. One explanation of the differences between the two groups is that consumers are free to use any words they experience, while the trained consumers are trained and calibrated, which in this case limited the number of words. Once again, consumers are not trained and may therefore be a bit confused about the meaning of the word, in comparison to the trained consumers who use a definition for each word (see Tables 1 and 2). Furthermore, Civille and Lawless (1986) argued that elicited words might create confusion between two words, e.g. in this case where consumers used soft and tender with no obvious difference between the two. The mechanical dimension of the attribute TOUCH shows some identical words or morphological variants
of the same word: *crisp* and *firm/firmness* where *crisp* has to do with cohesiveness and fracturability, while *firm/firmness* describes an aspect of the concept of “hardness” (“force to attain a given deformation” as Meilgaard *et al.* put it [2006: 11]). The hardness dimension is further described by the consumers with *hard* and *resistant*. When describing the soft end of the scale hard–soft, the trained panel used only one word, *tender*, while the consumers showed somewhat more linguistic variation: *soft*, *mealy*, *tender*, *dainty* (Swedish mjäll) and the phrase *easily chewed*. Following the categories of Meilgaard *et al.* (2006), another mechanical subproperty is “cohesiveness” (“degree to which sample deforms”) and to describe this dimension, the consumers used *crisp* and *crispy*, which both describe a high degree of fracturability, the deformed parts being probably prototypically different in size and shape (*crispy* = Swedish knaprig is not the same word as *krispig* [English *crisp*]). The phrase *chewing toughness* has also to do with the cohesive aspect. Another mechanical subproperty is “adhésiveness”, “force required to remove sample from a given surface”, to which category *sticky* and *mucky* would belong. “Denseness” is defined by Meilgaard *et al.* (2006: 11) as “compactness of cross-section”, and here the consumers used *dense* and *filling* (Swedish matig), which seem to express denseness and maybe also chewing toughness. The last subproperty of mechanical texture would be “springiness”, “rate of return to original shape after some deformation” and here, *resilient* is a clear member. When it comes to the geometrical texture dimension, the trained panel did not use any words at all in trying to catch any such sensory properties, while the consumers made use of *strong*, *thin*, *stringy*, *fleshy*, *rich*, *thickness*, *floury* and the phrase *round texture*. Of these, *strong* has the most puzzling meaning, in this context probably describing primarily both chewing toughness and firmness but maybe also some aspect of a tactile-perceived property (and also size and/or form, as do most geometrically oriented words). *Thin, stringy, round texture* and *floury* have more obvious visual components in contrast to for example *crisp*, but they may also describe a tactile perception. Among these, *stringy* and *floury* would be the most typical examples of words describing geometrical texture, since both clearly imply both a visual and a tactile aspect of an intersected piece of an item, which does not in the same degree seem to be the case of the more form-orientated *thin* and *round texture*, where the perception of particles is not semantically inherent in the same

Fig. 1 Sensory semantic frame for *babyleafs* based on trained panel’s vocabulary.
way. Fleshy (Swedish köttig) and rich (Swedish fyllig) seem – at least in the first case – to express a fibrous and somewhat heterogeneous texture, while thickness is more difficult to place, focusing not so much on the particle perception as on size, like thin discussed above. Anyway, it seems obvious that neither thin nor thickness could be understood as expressing mechanical texture properties. The fact that the trained panel did not use any geometrical texture words at all may partly be due to the thinness of babyleaves; they do not easily provide cross-section samples in the same way as do fish, meat, chocolate, fruits and the like. However, the trained panel discussed these types of words during the training period but were unable to agree on a defining term. In the model used here, texture also involves a dry–juicy dimension, and here, the trained panel used only one word, juiciness, where the consumers formulated dry, juicy, watery and astringent. But for the trained panel the word juiciness was bipolar, i.e. including both dry and juicy, so the lexical difference may of course be due to the fact that the moisture of the salad type mâche was described as...
low juiciness on an intensity scale by the trained panel, but with dry by the consumers. As for watery, this word would prototypically probably suggest a taste aspect, e.g. a low taste intensity regarding the sum of all detected flavours, or a watery consistency of for example a semisolid item like soup. But here, the consumers used it for describing a salad texture aspect, which thus would have to imply some sort of moisture presence since the interpretation here can hardly move in the soup direction. Astringent, finally, is not a self-evident member of the moisture family. The word describes a chemical feeling sensation, like the experience of metallic flavour, cooling menthol and spice heat (Meilgaard et al. 2006: 10). It seems thus to be included in TOUCH, though experienced in the mouth. The classification here is based on the assumption that most items that are astringent in touch would also have low juiciness.

3.1.2 Odour lexicon

The odour vocabulary of the trained panel does not take much space to comment on, since it consists of the single phrase odour intensity. As shown in Table 1, this is defined as “the intensity of the sum of all odours”, but it is unclear what odours would be the point of departure. This matter has been highlighted by Engen and Ross (1973) as a general problem of recognizing an odour with the right sensory label and property. Thus, it seems likely that a semantic frame approach might be a fruitful contribution to the field of sensory science, for example in the training of sensory panels. The vocabulary of the consumers offers more variation – except for the same phrase odour intensity, this lexicon is comparatively variegated. To get some structure of the vocabulary, some tentative semantic domains could be of use. The labels of these semantic domains are most often superordinates of the words within each domain. But as discussed by Aitchison, words often have more than one possible superordinate (1994: 92). To get a smooth and less rigorous internal-relational structure of the semantic domains, one could let them be influenced by semantic frame theory into a figure, table etc. where the root node, as in Barsalou’s model used in this study, is a single lexical unit, and the attributes are the two TYPE and PART, instead of only PART, which would be the actual case if the domain was to be constructed as a mere hyponymy (Larsson 2004: 51ff.). Doing so, such a semantic (or rather conceptual) domain would be very similar to a semantic frame. For Odour, the main semantic domain is the tentative GARDEN or, maybe better, the similar NATURE, where all the members describe different parts of the whole: grass, soil, summer flower, garden, forest, leaf, birch and fresh green. It is to be noted here that these words often show a further hierarchic relation: for example leaf is a meronymic subordinate of birch, which in its turn has the very same relation to forest. The other odour words with a pregnant semantic content may be named SPICES (pepper, spicy), HERBS (dill), VEGETABLES (spinach and cabbage, if the last one should not form a category of its own), ROOTS (beetroot, beetroot top), NUTS (nutt), OTHER FOOD ITEMS (mustard, cheese, egg) and two basic taste-related words, acidic and sweet. A residual category for the odour words would, except odour intensity, contain fresh and pleasant, which are affective words without any pregnant semantic profile and frame. This residual category may also include spring, even if there is a conceptual connection between spring and “nature”, and sultry.

3.1.3 Flavour lexicon

All the words/phrases used by the trained panel are also formulated by the consumers, with the one exception of fatty. The trained panels’ lexicon sketches two semantic domains: NATURE with the members grass and soil and VEGETABLES with the members cabbage and horseradish, which here via the attribute TYPE are specified into ROOTS (horseradish) and CABBAGE (cabbage). Left after these are nutty, pepper, fatty and the
3.3 Semantic Frames for Ruccola, Red Mangold, Mâche and Mustard; Semantic Frame

Other categorizations than those in Figure 3 would of course sometimes be possible; as an example, *dandelion leaf* could be housed within NATURE, *nutty* within OTHER FOOD ITEMS and so on. However, the domains sketched in Figure 3 show strong semantic links between the superordinate and the lexical subunits; in each unique relation, it is possible to assume one of the attributes TYPE or PART, with only two exceptions: (1) words morphologically derived from the superordinate such as *nutty* from *nut* (-s) and (2) cases where the superordinate also has occurred in the vocabulary such as *herbs*. Note here that such words, e.g. words occurring in the vocabulary but also used as superordinates in the semantic frame, are shown within parenthesis, for example (*cabbage*). The major semantic domains in the consumers’ flavour lexicon are ROOTS, VEGETABLES and OTHER FOOD ITEMS, followed by CABBAGE and HERBS.

3.2 Semantic Domains – Some Concluding Remarks

In all the three sensory dimensions, e.g. TOUCH, OLFACTION and GUSTATION, the vocabulary of the consumers shows the largest number of words, with the exception of Basic Taste, where the two vocabularies agree using all the words in Basic Taste. This is not
surprising, considering the very different contexts in which the lexicons were established. One interesting aspect is that Odour was described by only one phrase in the trained panel’s lexicon, namely, the very vague odour intensity, while the consumers’ lexicon showed more than twenty words, though some of them such as fresh lack pregnant semantic content. Several of the odour words in the consumers’ vocabulary recur in both flavour lexicons, such as grass, soil, spinach, dill, pepper and nutty. Independently of each other’s establishment, both flavour lexicons have cabbage and horseradish. Using trained sensory panels and consumers when eliciting words for food products is a well-established method in sensory science (Lawless and Heymann 1999; Meilgaard et al. 2006). But when it comes to actually capturing the relevant words for a food product for the purpose of marketing communication, for example in a grocery retail store, the semantic frame method may be a helpful tool in the development of unique selling words for a certain food product. Furthermore, using different sensory methods might be quite time consuming and expensive, for example using a semantic frame method, including a semantic domain analysis, as a first step in the training of the panel or in the consumer investigation could make the whole procedure more efficient.

3.3 Semantic Frames for Ruccola, Red Mangold, Mâche and Mustard; Semantic Frame Expansion

When establishing semantic frames for the salad types, we made use of both the trained panel’s and the consumers’ lexicon. As regards the consumers’ lexicon, the words being used are those that occurred five times or more, in addition to the position on the intensity scale of the property in question (for example cabbage, which was described as having a relatively high intensity for mustard, which is not the case of mâche). In addition, we also made use of some semantically pregnant consumers’ words. This is because of one of the purposes of the study, e.g. to expand and develop the sensory lexicon for babyleaves, and a strictly statistical method would make the different descriptions quite similar, the same descriptors being used but with variation in intensity. In the following, sensory semantic frames are presented for ruccola, red mangold, mâche and mustard (Figures 4, 5, 6 and 7). Some short comments on semantic domains for the four salad types will be given after each frame figure. These comments will highlight OLFATION and GUSTATION.

![Sensory semantic frame for ruccola](image-url)
The semantic domains evoked in the frame for *ruccola* are SPICES (*pepper*) for both odour and flavour. For flavour, they are ROOTS (*horseradish*), NUTS (*nutty*), NATURE/GARDEN (*grassy*), SPICES (*spicy*) and HERBS (*chives*). Thus, the most specified domains within flavour are ROOTS and HERBS. The domain of SPICE does not show the same degree of specification, since *pepper* seems much easier to specify (*black pepper, white pepper, Tellicherry black pepper, green pepper etc.*) than *chives* and *horseradish*, unless one specifies them by mentioning origin, fresh/dry/processed and the like.

The semantic domains evoked in the frame for *red mangold* are NATURE/GARDEN (*soil*) for both odour and flavour, and for odour only *grass*. For flavour, the domain of ROOTS is also evoked with the specification *beetroot*. These two domains are the only ones evoked here.

The semantic domains evoked in the frame for *mâche* are NATURE/GARDEN (*grass/grassy*) for both odour and flavour. The flavour domains are NUTS (*nutty*), OTHER FOOD ITEMS (*fatty*) and VEGETABLES (*sweet peas, spinach*). Since *fatty* is a rather unspecific term, including subspecies such as *lardo, olive oil, canola oil, butter* etc., this means that VEGETABLES is both the most specified and most extensive domain.
comprising two words. This is based on the assumption that both sweet peas and spinach would be more difficult to specify than fat.

The semantic domains evoked in the frame for mustard are NATURE/GARDEN (flower) for odour, and for flavour ROOTS (horseradish, radish, roots), SPICES (spicy), CABBAGE (cabbage) and VEGETABLES (sweet peas). The dominant domain here is ROOTS, being both specific (horseradish, radish) and unspecific with roots, a total of three words. VEGETABLE is also specific with the only member sweet peas.

We will now focus on the flavour descriptors cabbage, roots and nuts. Nutty is found in the frames for both ruccola and mâche, while cabbage and roots are included in the frame for mustard. As discussed earlier, one of the basic assumptions in semantic frame theory is that a certain concept, evoked by for example a word, comprises other concepts, some of which are obligatory, while others are prototypical and still others facultative. Thus, when the flavour descriptor cabbage is uttered and/or thought when someone tastes the salad type mustard, a semantic frame of cabbage is evoked, otherwise the meaning of cabbage cannot be understood. The exact content of the frame varies to some degree, of course, depending on contextual factors. Here, we will simply focus on the two attributes Colour (a subordinate of VISION) and TYPE. In Figures 8, 9 and 10 such partial semantic frames will be shown for cabbage, roots and nuts. The words in these three frames have been established by the authors, and thus represent not a specific group of informants or a specific text. The frames are built on common knowledge easy to look up in any encyclopaedia. It should for example be unproblematic assuming that the colours of different cabbage types could be white, light green, dark green and so on (but not silver or blue). Note here that the order of the types and the colours shows no symmetry; the colour words only express different colours that appear among the larger categories of cabbage, roots and nuts.

The semantic frames in Figures 8, 9 and 10 show some of the possible concepts evoked by the single words cabbage, roots and nuts. As said before, these are only parts of the frames for the three concepts in question; more extensive frames would also include attributes such as those studied earlier, e.g. TOUCH, OLFACTION and GUSTATION but also non-sensory attributes such as ORIGIN, PRICE, STORING, USE and the like. However, to construct sensory semantic frames for cabbage, roots and nuts would require sensory analysis of these items in the same manner as was done for babyleaves. But in a recent work by Civille et al. (2010), a large sensory vocabulary for almonds was established by a highly trained sensory panel. With parts of this vocabulary as a base, a sensory semantic frame of the same design as used hitherto in the study can be constructed for
the nut type almond. Thus, if one takes almond from the TYPE field in the frame for nuts (Figure 10) as a point of departure and for evoking sensory concepts included in almond, a sensory semantic frame could look like the one in Figure 11.

Since frames per definition are recursive, the words walnut, ham, tobacco etc. have their own frames, sensory and non-sensory, and in this way the frames never stop. For every new concept, a set of new attributive values is evoked that in their turn have attributes and values etc.
4. Conclusion

The initial semantic frame analysis showed how the two vocabularies could be organized into different sensory dimensions, including relevant subcategories for the attributes TOUCH and GUSTATION. The analysis of the flavour words illustrated some tentative semantic domains for the flavour lexicon. Four sensory semantic frames were constructed for the salad types ruccola, red mangold, mâche and mustard. These four frames showed different conceptual profiles and degree of specification. From some of the words included in these frames, three expanded semantic frames were constructed in order to illustrate the conceptual content of the frames. This expansion method, where words not directly uttered
by a panel or a consumer are evoked, suggests a way to develop the sensory language in the
detection and labelling of sensory properties.

The conceptual profiles of the different frames could also suggest a way to expand the
sensory vocabularies of certain products such as babyleaf salad, but also sensory vocabu-
laries in general. The fact that a semantic frame shows what concepts are evoked by and
included in another concept could make frames a useful tool in the semantic aspects of
commercial communication areas such as marketing and storytelling. Using the semantic
frame method could be an efficient tool and an accurate method to use in combination with
sensory science, as shown in the study by Swahn et al. (2010). This type of multidiscipli-
ary combination might be a fruitful approach in the process of developing an accurate
sensory language within the discipline of sensory and marketing science with different
aims. For example, for developing a vocabulary for food products within sensory science,
a highly trained sensory panel is often used for a very long time. This is very time con-
suming and expensive for the companies or the research team. Here, the semantic frame
approach might be a way to save time and money. So far, the grocery retail market too
predominantly shows a lack of accuracy in sensory marketing communication of the food
products’ sensory characteristics such as fresh, well balanced, tasty etc., and they might be
able to overcome this problem by using a more proper approach such as sensory semantic
frames. In marketing and product description in a grocery retail shop, it is important
to use the accurate words – e.g. if the consumer’s perception of the attribute is inconsis-
tent with the description, the utility of the product could be lost (Caswell and Modjuszka
1996). A further advantage of semantic frames is that they provide space for all kinds of
sensory descriptors, arranged as word groups with different attributes such as VISION:
Colour, Size; TOUCH: Texture: Geometrical and so on as superordinates. This distin-
guishes semantic frames from the frequently used wheel model (see for example Noble
et al. [1987] and Duffrin and Pomper [2006]). A semantic frame can also comprise other
attributes and descriptors than sensory ones, and the organization into attributes and values
makes the semantic links within the frame strong, which, as discussed in the Introduction,
is not always the case in the sensory wheels.

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NOTES
1 When translating the words from Swedish into English, the following works were consulted: the Lexin
online dictionary (December 2009 – January 2010), Stora engelsk-svenska ordboken (1980), Webster’s online

REFERENCES
Blackwell.
A Semantic Study in the Lexicon of Babyleaf Salad


ABSTRACT

Purpose – This observational study set out to investigate the effect of sensory description labels on consumer choice of apples in a grocery retail store.

Design/methodology/approach – An independent observation study was conducted in a retail grocery store setting. A total of 1623 consumers were observed over a four day period in four different sessions each using three apple varieties (JONAGOLD, INGRID MARIE, and ELISE). Labelling strategies differed between the sessions as follows: (1) brand name labelling, (2) sensory description labelling, (3) sensory semantic description labelling, and (4) tasted the apples before choosing in combination with sort name on the label.

Findings – Consumer product choice was affected by the sensory description labels. When only the brand name was given on the label, the consumers tended to choose the apples with a strong sort name, INGRID MARIE. With the addition of sensory description labels, the consumer choice shifted to ELISE, which had been chosen with a low frequency when only brand name was given, but was chosen with a high frequency when sensory description labelling was used.

Research limitations/implications – The study was limited to red apples and one national market.

Practical implications – This study reveals a possible benefit to practitioners, managers, and marketers of using proper sensory labelling as a marketing tool for various food products, such as apples, in a grocery retail store.

Originality/value – This study shows the importance and value of sensory description label marketing for food products in grocery retail stores. Little attention has previously been paid to the research area within sensory marketing communication concerning the interplay of sensory perception of food and the formulation of marketing labels, or taste marketing. This paper also addresses the possible interplay between the disciplines of sensory and marketing science.

Keywords – Labelling, decision making, sensory description, food, grocery retail store, preference

Paper type – Research paper
Sensory Description Labels for Food Affect Consumer Product Choice

European Journal of Marketing, in press

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INTRODUCTION

When aiming to influence consumer decision making, marketers and practitioners should try to engage and stimulate the consumers’ senses, which might affect their behaviour. It has already been noted that the marketing and advertisement of products generally addresses only our higher senses, sight and hearing, and tends to neglect the other senses (Lindstrom, 2005; Krishna, 2010). Instead of concentrating solely on sight and hearing, it would also be worth trying to take advantage of the other senses, such as taste, to increase the appeal and sensation of a product and make it more interesting to its intended consumers. Lindstrom (2005), Hultén et al., (2009), and Krishna (2010) argue that sense or sensory marketing is becoming more important for companies’ marketing strategies, for practitioners, and within academic research. For example, many grocery retail stores now use the scent of freshly-baked bread to entice the consumer into the store (Donovan and Rossiter, 1982). As Krishna (2010) puts it, “Sensory marketing will persist since senses can affect the marketing of products in many ways”. Elder et al., (2010) recommend devoting further attention to the interplay within taste experiences and cognition within sensory marketing. For example, in the purchase situation of a food product such as fresh fruit and vegetables, in most cases the colour and visual appearance of a product are quite obvious to consumers. We usually make our decision according to a “sniff-and-feel” test (Lindstrom, 2005), but it is worth considering the impact of taste preference too — how do the consumers know what kind of sensory eating experience and quality they are looking for and willing to pay for?

Sensory marketing could be seen as an important and growing research area in general. In this study we suggest how to combine the two disciplines, sensory science and marketing science, to enhance a sensory marketing communication approach in grocery retail stores and thus affect consumer choice of food products, in this case apples. It is well known that different attributes are relevant in consumer preference for products such as apples (Hedereley et al., 1996; Jaeger et al., 1998), and it is essential to elicit attributes that can be used in marketing labelling in a way that allows the consumer to relate to them (Wansink et al., 2000).

An exploitation of the sensory characteristics of a food product in a marketing strategy may affect or capture the attention of the consumers, and hence affect the often-habitual behaviour in a grocery retail store, which could be considered quite a difficult task (Kahn and Wansink, 2004). The average consumer makes about one major trip to the store per week (Caswell, 1997), spending approximately one hour in the store and being exposed to around 15 000 to 17 000 items (Caswell and Padberg, 1992). A consumer in a grocery retail store is exposed to around 300 items per minute (Kotler, 1996; Jaeger et al., 1998). The average consumer makes about one major trip to the store per week (Caswell, 1997), spending approximately one hour in the store and being exposed to around 15 000 to 17 000 items (Caswell and Padberg, 1992). A consumer in a grocery retail store is exposed to around 300 items per minute (Kotler, 1996; Jaeger et al., 1998), most of them with some type of external information provided by advertisements, packaging design, and so on.

To sum up, there are many variables that affect consumer choice of purchase of a food product in a grocery retail store. Fruit and vegetable departments generally do not provide any information about the sensory characteristics of their products; at most the price, brand, and sometimes origin are communicated. It would be of great interest to get the consumers to look and screen for their preferred sensory characteristics instead of, for example, the price. The importance of labels and descriptions in relation to consumer decision making in a grocery retail store raises the question of how sensory description of food products could affect consumer choice. Therefore, the overall objective of the present study was to evaluate the effect of sensory description labels on consumers’ choice of apples in a grocery retail store.
LITTERATURE REVIEW
SENSORY MARKETING

Sensory marketing in general has been defined by Krishna (2010) as a marketing strategy that engages the consumers’ senses and how it affects their behaviour. We are surprisingly unaware of the way our senses interact with our day-to-day experience. By engaging the senses in a decision-making process in grocery retail store could affect and influence the buying behaviour to create some interest and emotional response by the consumers which might affect their rational thinking (Kennedy, 2008). Sensory marketing could be assumed as a positive addition to today’s more traditional methods within marketing to send a certain message to more rational part of consumers’ consciousness (Murphy, 2005). In the present study sensory marketing communication may be a relevant approach in a contribution to a multi-sensory atmosphere around a food product in a grocery retail store by communicating the sensory characteristics and taste of the product itself.

However, research within sensory marketing to predominate date has mainly been focused on vision and hearing (Lindstrom, 2005; Hulten et al., 2009; Krishna, 2010) and little focus in how to emphasizing or bring attention to products existing sensations to increase a product’s appeal such as for food and taste. Maybe this is because our senses are attuned for danger detection rather than sensory delight. However the relationship and the links between marketing and how our senses work raise a number of questions. Sensory marketing could be considered as a useful approach since senses can affect the marketing of products in different ways (Krishna, 2010).

Sensory science with focus on food is defined by the Sensory Evaluation Division of the Institute of Food Technologists as to “evoke, measure, analyze and interpret reactions to those characteristics of food as they are perceived by the senses of sight, smell, taste, touch and hearing”. Sensory science has been used in different areas when it comes sensory marketing, such as Lee and O’Mahony (2005) who studied the concept of commercial toothpaste and appearance in relation to freshness using a ranking test for consumers. Moreover, within sensory science, the primary reason for developing a sensory language for a food product is to allow communication of the product’s sensory characteristics within different areas such as product development, quality control, and communication between sensory personnel, engineers, marketers, and other parties (Rodbotten, 2009, Lawless and Heymann, 1999). The concept of sensory food design according to Lindstrom (2005) is important and taste and smell will be ranked as very central, and that the industry will tamper with flavour to create new level of sensory preference. Much of the research on sensory language for food product has focused on development of a sensory terminology, lexicon, and dictionary for a specific product; this aspect is well covered in different articles such as Noble et al., (1987), Hongsoongnern and Chambers (2007), Civille et al., (2010) for wine, tomatoes, and almonds respectively. Thought yet within sensory science this type of valuable language, lexicon, never seems to taking further advantage of in a marketing purpose to communicate with the consumers’, e.g. in grocery retail stores. For example, Enneking et al. (2007), who studied consumer decision making regarding soft drinks, argued that sensory science for food with focus on intrinsic product attributes is not sufficient enough to meet the requirements of today’s fast moving markets and that extrinsic product information such as innovating labelling is important and may influence the consumers’ choice. However, Wansink et al., (2001; 2005) found that the use of descriptive names on restaurant menus (e.g. “Succulent Italian seafood filet” rather than simply “Seafood filet”) could increase sales by 27% and also affect the consumer’s perception of the meal. Though Wansink et al. (2001; 2005) generated the descriptive names based on brainstorming food related association within the research group; they did not conduct a sensory analysis of the product, dish, to create a proper flavour profile. Swahn et al., (2010) proposed a suitable sensory language model for red apples and methodology to construct this kind of labels for food products in a marketing purpose, which is used in present study. This raises the question of whether this approach would be as
successful in a grocery retail store setting for affecting choice and preference of food products as Wansink et al. (2001; 2005) showed.

Also, according to the model developed by Akerlof (1970) concerning information on product quality by using the "market for lemons" (used cars) as an example, it was suggested that quality product market may disappear in place for the lowest quality products may be sold if seller is unable to communicate the quality aspects to consumers. It could be assumed that grocery retail stores which make claims about the quality of their products, or which make a point of marketing their products’ sensory characteristics, would be perceived as a store with high quality products. Caswell and Padberg (1992) have similarly argued that manufacturers who market their quality status will be so perceived, and manufacturers who do not will likely be perceived by the consumers as having a lower quality of product.

The decision-making process for food and purchase are complex phenomena and could be influenced by several marketing, psychological and sensory related factors which could be referred to as marketing-related (Carneiro et al., 2005). The food labels are associated with food purchase decision and assist consumers in making food choices (Kriflik and Yeatmen, 2005).

**Sensory descriptions when searching food product**

Food labelling in a grocery retail store is meant to provide different types of information and knowledge about the food item (Dimara and Skuras, 2005), and it may act as an external influence for the consumer’s in their search. However, labelling research to date has predominantly focused on aspects such as nutritional and health claims, product ingredients, policy, product origin, and safety (Caswell and Mojduszka, 1996; Miller et al., 1998; Baltas, 2001; Bereau and Valceshini, 2003; Wansink, 2003; Wansink, 2004; Borra, 2006), rather than the value of communicating the product’s sensory characteristics. Dimara and Skuras (2005) argued the relevance of food labels as an important marketing strategy. They concluded that food labelling should be carefully designed to communicate relevant quality attribute to be able to create appropriate labels to meet that criteria and to be able to convey quality attributes to the consumer effectively to create a need. The wine industry is a good example of this; they have established a sensory language and methods for describing the product’s sensory characteristics (Herdenstam et al., 2009). This type of language is used in marketing in many ways to influence and communicate, for example in advertisements, on bottle labels, on restaurant menus, by sommeliers, in beverage stores, and so on. Wine labels are considered important by wine consumers, in that they provide information such as location, certifications, and sensory attributes (Dimara and Skuras, 2005).

Research concerning the importance of wine labels for consumer buying behaviour and consumer preference in the context of consumption has been highlighted in a number of studies (Dimara and Skuras, 2005; Charters and Pettigrew, 2003; Ling and Lockshin, 2003; Thomas, 2000). Moreover, wine labels are considered to be an important and cost-effective marketing strategy when it comes to communicating and affecting consumers’ evaluation of alternatives for wine purchase (Rocchi and Stefani, 2005). Mueller et al., (2010) reported that the message on the wine bottle and the information on the back label had a positive effect on the overall decision-making process. It could be considered that wine is a relatively complex product with regard to aspects such as region, sub-region, origin, style of vineyard, vintage, grape variety, style and some sort of storytelling. Also, short health claims on the front of a package are sought by the less involved consumer, while more comprehensive health information on the back of a package is sought by more involved consumers (Wansink, 2003). However, it has been found that too much information can lead the consumer to make a poorer decision making, while too little information may be misleading (Jacoby et al., 1974; Wilke, 1974).
Sensory descriptions when comparing food products

Bettman et al., (1998) highlighted the theory of constructive consumer choice process and declared that consumers may not have a master list of preference in memory, past experience, when making a choice. The process of evaluate the alternatives depend on consumer’s ability to perceive and process the label information (Dimara and Skuras, 2005). Wansink et al., (2004) have reported that shorter descriptions may lead to more positive beliefs about the product, which may affect their evaluation of search. Consumers who ignore or do not understand the descriptions or labels are considered to be more likely to evaluate the product as “good” or “bad” in comparison to consumers who read and understand these descriptions, and who most likely are able to express themselves in more specific terms. This might have to do with a person’s ability to process and reflect the types of thoughts (s)he generates when reading the labels etc., and it may have to do with that not all consumers’ not equally will be influenced by the labels (Wansink and Parker, 2002). It could be argued that consumers need marketing information, such as sensory description labels, to be inspired and be able to solve the problem of evaluating the alternatives, for instances, to try new food products and also to act as retrieval cue at the time of the decision-making process. The grocery retail store offers a great deal of products and most consumers think about their choice of product for all of two seconds (Lindstrom, 2009).

Wansink’s (2005) theory on why labels have an impact on consumers is that descriptive labels allows consumer to concentrate more on their feelings and on the expected taste of the food during the decision-making process. Using the right type of description or words in a marketing strategy could be essential for the information search; for example, Wansink et al., (2000) have shown that describing the content of nutrition bars as “soy protein” had a negative effect on consumer liking, and that the bars were more likely to be described as grainy and having a strong aftertaste in comparison to when the word “soy” was excluded. It could be argued further if “soy” may correlate with a negative past experience? Also Cameiro et al., (2005) addressed similar theory, who investigated consumers’ intention to purchase soybean oil with different labels and information, found that the attribute “transgenic” had a negative effect. According to the discussion above the efficiency of labelling has been questioned as an informational source and how efficient the labels are as direct shopping aids depends on how comprehensible and sufficient the labels are (Dimara and Skuras, 2005).

Grundvåg and Østli (2009) revealed in a store observation concerning unbranded and unlabelled food products that the consumers not only evaluate the visual appearance of the product, but also touched and smelt it to determine the products quality within the evaluation of alternatives of products. The touch and feel procedure for fruit in a grocery retail setting has also been shown by Peck and Childers (2006) to affect the consumers evaluation of alternatives. While this typical procedure could allow consumers to determine the quality and ripeness of the product, for example with an avocado which must be touched in order to gauge its ripeness, it will not provide any information on the expected sensory eating quality.

The stage of evaluation of search could be argued as critical in some cases; Park et al., (1989) argued that the decision-making process might deteriorate if the consumer is under time pressure. Though when it comes to consumer’s ability to remember information in the evaluating process is quite limited (Baddeley, 1997; Baars et al., 2003). It is worth asking how the communication of a product’s sensory characteristic appeal could be improved. Also the manner in which the language is used on the labels influences how consumers process and access information. The choice of words and terminology can also influence how the label information is categorized and further evaluated to form a choice or judgement (Meyers-Levy et al., 2010). Though, it has been shown that expectations arising from labelling communication can cause olfactory illusions; for example, odours were evaluated as more pleasant when they were presented with positive rather than negative labels. Parmesan cheese with an odour described as “isovaleric+ butric acid” was more likely to be eaten than the same cheese with its odour described as “vomit” (Herz and Clef, 2001). This shows that the
decision making of consumers can be affected by the communication of sensory experiences; or, as stated by Herz (2010) concerning sensory stimuli and odour: “The shrewd sensory marketer could use these factors to elicit maximum impact in product labelling and branding”. However, communicating the sensory characteristics of a food product in a grocery retail store might not be as straightforward as one might think; the use of sensory language or description and the choice of words are essential for consumer credence (Swahn et al., 2010).

**Sensory descriptions when purchasing and evaluating food products**

Attributes such as taste and texture will most likely be determined by the consumer after the product is purchased and consumed (Dimara and Skuras 2005). If the consumer’s perception of the sensory attributes is at odds with the information and labels provided by the grocery store, the consumers could lose confidence of the product (Caswell and Modjuszka, 1996). Moreover, consumers may have different levels of product knowledge, past experience of the food product, the labels may help the consumers to interpret new information in the pre-purchase search (Peter et al., 1999), and consumers may construct their preference on the spot when reading the labels when they must make a choice of purchase (Bettman et al., 1998).

de Chernatony and Harris (2000) declared when providing an added value for the consumer might lead to higher prices, and margins for the selling company. Furthermore, different products will have different sets of sensory characteristics, and the importance of the attributes that are present and communicated could also affect the consumers’ willingness to pay (McCluskey et al., 2007). Fotopoulos and Krystallis (2003), who examined the Greek market and consumers’ attitudes towards quality labels, found that consumers might be more willing to pay a higher or premium price for apples with a quality label.

**EXPERIMENTAL APPROACH**

To fulfil the aim of this study, an observational survey was conducted with a quantitative, independent, and prospective design (Altman, 1999). The study was performed over a four day period in the fruit and vegetable departments of two different grocery retail stores. These stores were selected to provide a typical sample of consumers in a grocery retail store. A total of 1623 consumers were observed (47% male; age divided into three different subgroups; ≤25, over 25 but under 65, and ≥65 (Note that age and gender are not analyzed further in this report). The observations during the study period were distributed between both grocery retail stores. Consumers were observed in three major parts of the day (morning, afternoon, and evening) across the two stores in order to reduce biases due to shopping environment and age. Each consumer’s choice of apple was documented together with age and gender on protocol sheets. There were four assessment sessions in the study: (1) sort name labelling, (2) sensory description labelling, (3) sensory semantic description labelling, and (4) tasted the apples before choosing in combination with sort name on the label and three different apple varieties were used: JONAGOLD, INGRID MARIE, and ELISE (see Figure 1). The difference between session two and session three involved just a few extra semantic attributes, which are shown in italics in Figure 1. In designing the labels, we used the sensory description for red apples based on the sensory study by Swahn et al., (2010) for the labels in session two. Labels in session three we developed an extension of the labels in session two by using the semantic frame theory. The samples were also selected according to the result of Swahn et al., (2010) and to be distinguished by their sensory profile (note: the INGRID MARIE and ELISE were grown in Sweden, while JONAGOLD apples were imported). The labels were designed along the same lines as existing labels in the grocery retail stores; A4-format, black and white, and using the companies’ own fonts and sizes, in order to blend in with the actual grocery retail stores’ labels.
A station was set up within the fruit and vegetable department at each grocery retail store. The apples were presented in baskets in front of each label, and were selected and matched by colour and size in order to minimize any visual differences, since sometimes the greatest variation of the product occurs in its appearance (Risvik, 1992). The baskets contained an even distribution by amount. The presentation order of the apples was the same during the entire study, because of the impracticality of changing the presentation order. Before beginning the observations, a trial session was conducted to detect and prevent any ambiguities. The consumers were free to read and interpret the labels and taste the apples in any order they liked. Consumers were approached in the store by the observer and asked to participate in a short study involving preference of choice for apples. Once the consumer agreed to participate, the observer welcomed and instructed him or her in the following order 1) welcomed the participant, 2) instructed the participant to read and evaluate the labels and to make a choice according to preference and in session four the consumers were instructed to taste all three apples and then make their choice, and 3) urged the participant to take the selected apple and have a bite (this part was neither registered nor analyzed in present paper).
### Session 1 (S1)  
**Brand name**  
N=411

<table>
<thead>
<tr>
<th>JONAGOLD</th>
<th>INGRID MARIE</th>
<th>ELISE</th>
</tr>
</thead>
</table>

### Session 2 (S2)  
**Sensory description**  
N=400

<table>
<thead>
<tr>
<th>JONAGOLD</th>
<th>INGRID MARIE</th>
<th>ELISE</th>
</tr>
</thead>
</table>
| High odour intensity in peel and flesh, odour of pear  
Very juicy and tender, some mealessness, low chewing toughness  
Sweet apple, low acidity, flavour of pear, quite high flavour intensity | Some citrus odour in flesh  
Quite juicy, crisp, firm apple, some chewing toughness  
Low sweetness, quite acidic | High odour intensity in flesh, odour of citrus  
Very firm and crisp, relatively high chewing toughness  
Low sweetness, high acidity, high flavour intensity and some astringency |

### Session 3 (S3)  
**Sensory and semantic description**  
N=413

<table>
<thead>
<tr>
<th>JONAGOLD</th>
<th>INGRID MARIE</th>
<th>ELISE</th>
</tr>
</thead>
</table>
| High odour intensity in peel and flesh, odour of pear and perfume  
Very juicy and tender, some mealessness, low chewing toughness  
Sweet apple with a touch of banana and grape, low acidity, flavour of pear with a touch of perfume, quite high flavour intensity | Some citrus odour in flesh  
Quite juicy, crisp, firm apple, some chewing toughness  
Low sweetness, quite acidic with a touch of lemon and orange | High odour intensity in flesh, odour of citrus  
Very firm and crisp, relatively high chewing toughness  
Low sweetness, high acidity with a touch of lemon, high flavour intensity and some astringency |

### Session 4 (S4)  
**Brand name and taste preference**  
N=399

<table>
<thead>
<tr>
<th>JONAGOLD</th>
<th>INGRID MARIE</th>
<th>ELISE</th>
</tr>
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<tbody>
<tr>
<td>Taste preference</td>
<td>Taste preference</td>
<td>Taste preference</td>
</tr>
</tbody>
</table>

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**Figure 1.** Labels for three apple varieties (JONAGOLD, INGRID MARIE, and ELISE) for four sessions (brand name, sensory description, sensory and semantic description, and brand name and taste in combination).
In the following section, we first present the findings from the observation study for each product and session, and then expand on these results by fitting a nominal logistic regression model to analyse the probability of choosing an apple in each session.

**FINDINGS**

This section first presents the frequency distributions of the preferred apples in the different sessions as bar charts to allow visualisation of the ranking for each session. The second part presents the choice of an apple within sessions.

*Choice of apple with different labels*

The frequency distributions of apple choice in the different sessions are shown as bar charts in order to allow visualisation of the rankings of the most frequently chosen apple of each session (see Figure 2).

Figure 2 shows that in the first session (S1), when only the sort name was given, 45% of the 411 consumers chose INGRID MARIE, 31% chose ELISE, and 23% chose JONAGOLD. In session two (S2), when the labels also contained sensory descriptions, 50% of the 400 consumers chose ELISE, 31% chose INGRID MARIE, and 19% chose JONAGOLD. Session three (S3), using labels with sensory semantic descriptions, revealed results quite similar to those in session two; 43% of the 413 consumers chose ELISE, 33% chose INGRID MARIE, and 23% chose JONAGOLD. The order changed again in session four (S4), when the consumers chose apples according to sort name in combination with taste preference; 44% of the 399 consumers chose INGRID MARIE, 38% chose JONAGOLD, and 19% chose ELISE (see Figure 2).

![Choice of apple for each session](image)

*Figure 2.* Cumulative percentage frequency histogram of consumer choice of apple (%) for each apple and session in which the median and quartiles were indicated (the 50th, 25th and 75th centiles).
To extend the analysis of Figure 2, we also conducted a t-test with significance set at $p<0.05$ to investigate the differences between apple varieties and sessions (see Table 1).

The JONAGOLD apple was chosen with the lowest frequency when sort name, sensory description, and sensory semantic description labels were shown. On the other hand, in session four, when sort name and taste were used in combination, this variety was chosen with a higher frequency. By comparing the sessions, it can be seen that the consumers preferred JONAGOLD with sort name and taste in combination.

As seen in Figure 2, INGRID MARIE was chosen with a relatively high frequency for both sort name alone and sort name and taste in combination. A comparison of the sessions shows that consumers were more likely to choose INGRID MARIE when sort name or sort name and taste were given, in comparison to when sensory characteristics were given.

ELISE scored the highest frequency in sessions two and three, when sensory or sensory and semantic descriptions were given. It scored the lowest frequency in session four, when sort name and taste were given in combination (see Figure 2). Comparing the sessions for ELISE reveals that communicating sensory and sensory semantic descriptions was more favourable than communicating sort name and sort name and taste in combination.

Table 1. Comparison of the differences of percentage (figure 2) between sessions and samples. Differences with a $p$-value $<0.05$ are considered significant.

<table>
<thead>
<tr>
<th></th>
<th>Session 1 &amp; 2</th>
<th>Session 1 &amp; 3</th>
<th>Session 1 &amp; 4</th>
<th>Session 2 &amp; 3</th>
<th>Session 2 &amp; 4</th>
<th>Session 3 &amp; 4</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>P-value</strong></td>
<td>0.077</td>
<td>0.5</td>
<td>0.001</td>
<td>0.077</td>
<td>0.001</td>
<td>0.001</td>
</tr>
<tr>
<td>Jonagold</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Ingrid Marie</td>
<td>0.001</td>
<td>0.001</td>
<td>0.344</td>
<td>0.270</td>
<td>0.001</td>
<td>0.001</td>
</tr>
<tr>
<td>Elise</td>
<td>0.001</td>
<td>0.001</td>
<td>0.001</td>
<td>0.040</td>
<td>0.001</td>
<td>0.001</td>
</tr>
</tbody>
</table>

Choice of an apple within sessions

To expand the results shown in Figure 2 and Table 1, the data were fitted to a nominal logistic regression model, with odds ratios (ORs) used to estimate probabilities. The reference category for the session was session four; JONAGOLD and ELISE was used as reference category in the first and second regression model, respectively, and was used as the reference category for the dependent variable and different sessions for the independent variables to analyze the consumers’ choice between apples (see Table 2).

The probabilities of choosing INGRID MARIE and JONAGOLD did not obviously differ between the sessions. However, INGRID MARIE could be considered to be more popular in session one, when sort name was communicated, though with a fairly small margin between the two (1.68).

When comparing ELISE and JONAGOLD in session two, the estimated probability was 5.17, showing that consumers were more likely to choose ELISE than JONAGOLD when sensory description labels were communicated. The results were similar when comparing ELISE and JONAGOLD with sensory semantic description labels (session three), ELISE calculated to be chosen with a higher probability (3.16). However, JONAGOLD was more likely to be chosen by the consumers when sort name and taste were given in combination.
Comparison between INGRID MARIE and ELISE showed that consumers were more likely to choose ELISE when sensory descriptions or sensory semantic descriptions were given (3.33 and 2.38, respectively). On the other hand, ELISE was less likely to be chosen when sort name and taste were given in combination.

Table 2. Results of fitting the nominal logistic regression model with session four as reference category (explanatory variables are different sessions, reference category for response is JONAGOLD and ELISE).

<table>
<thead>
<tr>
<th>Parameter β</th>
<th>Estimate b</th>
<th>Std. Error</th>
<th>Odds ratio, OR = exp(b)</th>
<th>95% confidence interval</th>
</tr>
</thead>
<tbody>
<tr>
<td>( \log(\pi_2 / \pi_1) ): INGRID MARIE vs. JONAGOLD</td>
<td>( \beta ) (constant)</td>
<td>-0.058</td>
<td>0.222</td>
<td>1.68 (0.91, 3.11)</td>
</tr>
<tr>
<td></td>
<td>( \beta ) (session1)</td>
<td>0.519</td>
<td>0.314</td>
<td>3.16 (1.52, 6.58)</td>
</tr>
<tr>
<td></td>
<td>( \beta ) (session2)</td>
<td>0.444</td>
<td>0.314</td>
<td>1.56 (0.84, 2.88)</td>
</tr>
<tr>
<td></td>
<td>( \beta ) (session3)</td>
<td>0.293</td>
<td>0.314</td>
<td>1.34 (0.72, 2.48)</td>
</tr>
<tr>
<td>( \log(\pi_3 / \pi_1) ): ELISE vs. JONAGOLD</td>
<td>( \beta ) (constant)</td>
<td>-0.945</td>
<td>0.264</td>
<td>1.91 (0.92, 3.97)</td>
</tr>
<tr>
<td></td>
<td>( \beta ) (session1)</td>
<td>0.647</td>
<td>0.374</td>
<td>5.17 (2.49, 10.76)</td>
</tr>
<tr>
<td></td>
<td>( \beta ) (session2)</td>
<td>1.643</td>
<td>0.374</td>
<td>3.33 (1.52, 6.58)</td>
</tr>
<tr>
<td></td>
<td>( \beta ) (session3)</td>
<td>1.151</td>
<td>0.374</td>
<td>3.16 (1.52, 6.58)</td>
</tr>
<tr>
<td>( \log(\pi_2 / \pi_3) ): INGRID MARIE vs. ELISE</td>
<td>( \beta ) (constant)</td>
<td>0.887</td>
<td>0.261</td>
<td>1.13 (0.43, 1.81)</td>
</tr>
<tr>
<td></td>
<td>( \beta ) (session1)</td>
<td>-0.128</td>
<td>0.369</td>
<td>1.13 (0.43, 1.81)</td>
</tr>
<tr>
<td></td>
<td>( \beta ) (session2)</td>
<td>-1.199</td>
<td>0.369</td>
<td>3.33 (0.15, 0.62)</td>
</tr>
<tr>
<td></td>
<td>( \beta ) (session3)</td>
<td>-0.858</td>
<td>0.369</td>
<td>2.38 (0.21, 0.87)</td>
</tr>
</tbody>
</table>

**DISCUSSION**

Our findings show that the consumers chose a certain apple to a higher extent when only sort name was communicated; unsurprisingly, INGRID MARIE, which is a very popular apple on the Swedish market, was chosen with the highest frequency. In this first session, the consumers did not spend a great deal of time evaluating the sort name labels, and the observer observed a more habitual behaviour. In this session, the consumers were not particularly interested in the task of choosing an apple; there was nothing there to get their attention and thus affect their involvement. This might be because the communication of sort name is normal for apple labels in a grocery retail store setting, an assumption supported by general comments from the consumers during session one, for example; “This is an easy task, I choose... that’s my favourite apple, I purchase that all the time”. Hence, our findings indicate that consumers are most likely to make a more habitual choice of product, with low involvement, when only the sort name is communicated in a marketing strategy. The
difficulty of actually getting the consumer’s attention during the purchase decision in grocery retail stores has also been discussed by Kahn and Wansink (2004). When the consumers were exposed to the sensory description and sensory semantic description labels in sessions two and three, respectively, their choice of apple shifted, with ELISE now being chosen with the highest frequency. This is quite a surprising finding, considering that ELISE was chosen with the lowest frequency when only sort name and sort name and taste in combination were communicated to the consumers. In addition, ELISE was considered as quite unfamiliar by the consumers’ compared to INGRID MARIE which the consumers’ were familiar with. This is hence an important result which indicates that consumers are affected by sensory and sensory semantic description labels for apples. In this case, ELISE is to be considered as an example for communicating some appealing attributes in sessions two and three (see Figure 1). It is well known that different attributes have different relevant importance for consumer preference regarding apples (Hedderley et al., 1996; Jaeger et al., 1998), and it is essential to elicit appropriate attributes for use on marketing labels, to allow the consumer to relate to them (Wansink et al., 2005). This is one of the reasons why the approach of combining the two disciplines of sensory and marketing science is important, and why advantage should be taken of the terminology used within the sensory science procedure.

The aim of the observational study did not include observation of the overall consumer behaviour during the choice of apple, though a higher involvement by the consumers was noticed by the researchers when the consumers evaluated the labels with sensory characteristics. This result is in line with previous work showing that sensory description menus in a restaurant setting affected consumer choice (Wansink et al., 2001; 2005); our findings indicate similar results with more extensive sensory description labels. Wansink et al., (2001; 2005) also reported that descriptive labels have a positive influence on customers’ attitudes toward a restaurant and their intention to return. This is a very interesting perspective; one of our intentions in developing sensory descriptive labels is that the customer is satisfied with the product and thus acquires the intention to revisit the store and repurchase the product (note that this was not the aim in the present study). Moreover, another effect of this might be that described by de Chernatony and Harris (2000), who declared that this kind of approach may lead to higher consumption, prices, and margins of the product. Wansink et al., (2001) also showed that descriptive labels increased sales by more than a quarter and increased the likelihood that customers would purchase the products again on return visits.

When only the sort name is communicated, the screening process could be assumed to be quite an easy task for the consumers, but when text covering the sensory characteristics is provided, the screening process is more time consuming and not that obvious. A more thorough label, such as a sensory descriptive label, requires the consumer to interpret and evaluate their own preference in their choice of purchase. As mentioned earlier when describing the theoretical background, labelling communication today mainly focuses on nutrition and health claims, product ingredients, policy, origin, and other such aspects (Caswell and Mojdzska, 1996; Miller, 1998; Baltas, 2001; Beraud and Valcshini, 2003; Wansink, 2003; Wansink, 2004; Borra, 2006), and therefore sensory characteristics labels for apples might be seen and interpreted as quite new and unfamiliar to consumers. The general information provided today in apple labelling mainly covers price, origin, and sometimes a quality classification, but most people are unlikely to be used to communicating the sensory characteristics of food products with a specific sensory vocabulary, and therefore this type of marketing label could be considered to be an interesting and unfamiliar approach for the consumers in a grocery retail store. Another aspect of interest is that the consumers in our study interrupted their habitual behaviour, and took their time to evaluate the labels in the effort to make their choice. In this case the consumers had to construct their preference on the spot when reading and evaluating the labels which may affect the consumer’s choice, as argued by Bettman et al., (1998). Given this, a sensory descriptive label might be one way to actually capture attention and interrupt the often habitual behaviour, as described by Kahn and
Wansink (2004), of the consumers in a grocery retail store. Several other aspects concerning the impact of consumer decision making in the grocery retail store may also affect this issue further, for example time pressure (Park et al., 1989), which could be a critical aspect when it comes to descriptive label advertisements. The number of products in the store (Caswell and Padberg, 1992) poses another dilemma when using descriptive labels. It is also worth asking how the labels should be used, for example as big posters or as labels on the shelves. Consumers are exposed to a large number of items per minute within the grocery retail store (Kotler et al., 2008), which makes the competition even harder. It could also be assumed that shorter descriptions could be easier for the consumers to comprehend and screen, allowing them to compare the products’ favourable and unfavourable attributes within the choice of purchase. This also corresponds with the findings from different studies highlighting how the extent of the labels is essential for the consumers (Jacoby, Speller and Kohn, 1974; Wilke, 1974; Wansink, 2003; Wansink et al., 2004). The extent of the sensory description in sessions two and three, sensory description and sensory and semantic description respectively could be argued to be quite excessive in terms of the number of communicated words. For example, the consumers seemed to struggle when trying to compare the labels, and had usually forgotten the message from the first label by the time they had read all three labels. As human beings, our visual memory is restricted in how many units we are able to remember (Baddeley, 1997; Baars et al., 2003) and therefore this should be taking into account in the future applications. The strategy mentioned by Wansink (2003), of providing short health claims on the front of the package and more extensive information on the reverse, may offer one way to overcome the problem with too much information on the label. In this case, this would involve advertising the essential sensory characteristics in bigger fonts, with just a few words (unique selling points), followed by a more thorough sensory description at the lower end of the label in a smaller font. It should also be taken into account that this approach may vary in relation to product, for example it could be useful for premium products to brief a short explanations showing what a product taste like or how to use it etc.

The present study was focused on the use of sensory description labels in grocery retail stores and their effect on the consumer’s choice of product. The effect of communicating both sort name and taste preference (session four) was also observed. While INGRID MARIE was considered as the winner when the consumers were given only the sort name, it is also worth considering what happened when the consumers made their choice based on sort name and taste in combination. Taste experience may be the best way to actually get a proper perception of the quality of the product. This type of procedure is used from time to time in grocery retail stores, especially during promotion of a certain product, but it is not possible to use it at all times and for all products. An interesting finding was that the consumers still chose INGRID MARIE with the highest frequency when they were given sort name and taste in combination. This might be because INGRID MARIE is a well-known sort and quite popular, as shown in session one (sort name), and therefore the consumers in session four were already familiar with its taste. Surprisingly, the consumers chose ELISE with the highest frequency when sensory and sensory semantic descriptions were shown and with the lowest frequency when sort name and taste were given in combination. As mentioned above, the descriptions for ELISE in sessions two and three could be considered as quite favourable for the consumers. Moreover, the consumer was not consistent in choice of apple when comparing sensory and semantic description labels in session two and three with the taste experience in session four. It would be of interest to further investigate how a sensory description label in relation with experienced taste is affecting the consumers’ choice.

Communicating sensory qualities is not as straightforward as one might think; it is essential to communicate the right sensory characteristics. As shown by Wansink et al., (2000), who reported that the use of the phrase “soy protein” on nutrition bars had a negative effect, it is possible that the JONAGOLD apple could have suffered from the use of the word “perfume” in the description given in the present study. Both
important; we as humans are becoming more interested in what we eat and what we can expect from a
proper food with the right amount of calories and other nutrients, but the taste of the food is also

study by Wansink (2005) with some surprising results. However, it could be argued that the sensory descriptions used in the
marketing or taste marketing approach, with a focus on taste and consumer behaviour, is relevant in the
grocery retail store setting.

the smell of bread), communicating the sensory characteristics may be an innovative way to market food
products in a grocery retail store. Of all the ways we could affect consumer purchase decisions in a grocery retail store (e.g.
grocery retail stores are that sensory descriptive labels can help and stimulate first-time consumption, and

LIMITATION AND FUTURE RESEARCH

There are several limitations to this research. For example, it focuses only on consumers in the Swedish
market and on the choice of apples available in a certain time period in a single country. It is not certain that
our results can be replicated elsewhere in the world, but they do give some hints about what practitioners,
marketers, and managers can do to affect consumer choice in a grocery retail store.
As highlighted by Elder et al., (2010), the interplay within taste experience and sensory marketing needed further attention, and has been shown in the present study to affect the consumer’s choice of product. However, this is an interesting field of sensory marketing, combining sensory and marketing science, and particular taste marketing. Over the years, the wine industry has successfully and impressively taken advantage of sensory descriptions and applied them as a marketing tool. Hence, this approach deserves greater attention within taste marketing, to allow practitioners to take advantage of the sensory science approaches and findings and use them as a marketing tool in settings such as grocery retail stores. Sensory scientists are expert at the task of attempting to use humans to evoke measure, analyze and interpret reactions to those characteristics of food as they are perceived by the senses of sight, smell, taste, touch and hearing and applying this knowledge within sensory marketing could be a factor in success. What this means for managers and practitioners within grocery retail stores is that sensory descriptive labels can help and stimulate first-time consumption, and maybe help encourage repeat sales. An important question before using a similar approach in a grocery retail store is to consider and take into account that this may not be a suitable approach for all products in a grocery retail store.

Future research concerning sensory descriptive labels could also look into the effect of label information in relation to price, visual appearance, and taste preference to see how consumers change or do not change their choice of product. Also, how could we develop symbols communicating taste attribute and intensity to make it easier for the consumers’ to screen and interpret the labels?

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ABSTRACT

By combining different methods and theories from sensory analysis and consumer behaviour, we investigated consumer choice of food products in a grocery retail store according to different sensory marketing cues across three observational experiments. Depending on the specific experiment in which they participated, consumers made their choice based on visual appearance, taste, and price; or descriptive labels, taste, and price. When presented with the opportunity to taste the products and examine their prices, the consumers were less likely to change their minds after making their initial choice if this choice was made on the basis of sensory description labels. Consumers were less price sensitive when sensory description labels were used. Our results reveal some practical implications for how to use a sensory language for food products as a marketing tool, and how to combine the research disciplines of sensory analysis and consumer behaviour.
Different Sensory Marketing Cues Affect Consumers’ Food Choice Behaviour

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ABSTRACT

By combining different methods and theories from sensory analysis and consumer behaviour, we investigated consumer choice of food products in a grocery retail store according to different sensory marketing cues across three observational experiments. Depending on the specific experiment in which they participated, consumers made their choice based on visual appearance, taste, and price; or descriptive labels, taste, and price. When presented with the opportunity to taste the products and examine their prices, the consumers were less likely to change their minds after making their initial choice if this choice was made on the basis of sensory description labels. Consumers were less price sensitive when sensory description labels were used. Our results reveal some practical implications for how to use a sensory language for food products as a marketing tool, and how to combine the research disciplines of sensory analysis and consumer behaviour.
INTRODUCTION

Consumers in a grocery retail store process a large amount of information when making a food choice, and their decisions are affected by the way in which this information is received and processed (Bettman, Luce, and Payne 1998). Grocery retailers are faced with the question of whether they should use descriptive ads for food, price ads or maybe offer different taste samples. It is necessary then to ask how we can attract the attention of these consumers and influence their choice of product. However, even a brief glance at the advertisements currently used within grocery retail stores will show that these advertisements do not generally refer to the objective taste experience and the sensory characteristics of the product. Instead, it is a fairly common practice to use more subjective descriptions such as “tasty,” “good,” or “gourmet,” or to employ ambiguous descriptions which generally include no information on how the product would be perceived in terms of taste. Marketing the sensory characteristics of food products may be a relevant approach which contributes to a multi-sensory atmosphere around a food product in a grocery retail store. Within the field of sensory science, different kinds of vocabularies and lexicons for describing the appearance, aroma, flavour, and texture characteristics of different food products have been developed over the years, covering for example almonds (Civille et al. 2010), fresh leaf vegetables (Talavera-Bianchi, Chambers, and Chambers 2010), and cheese (Yates and Drake 2007). This type of language is often developed and used by researchers, food companies, producers, and manufacturers for internal communications. We explore how this type of sensory description labels may affect the consumer choice behaviour in a grocery retail store, in relation to visual appearance, taste preference, and price. The process of understanding human beings and the ways in which we choose different food products according to different sensory marketing cues in a grocery retail store is essential for marketers, advertisers, and retailers, among others. The literature review below gives a brief overview of sensory and marketing science with a focus on consumer choice behaviour in relation to food products.

LITERATURE REVIEW
SENSORY STIMULI AND CONSUMER BEHAVIOUR

Within the discipline of psychology and human behaviour, conscious (explicit) and non-conscious (implicit) vision and hearing are characterised by inborn mechanisms which allow all human beings to perceive the world in the same way (Peck and Childers 2008). Taste and smell do not function with the same perceptual accuracy, as they are not inborn but instead rely on learning, memories, and experiences (Köster 2003). Human perceptions of food are complex sensory and interpretative processes, and are influenced by many interaction factors (Köster 2009). It is not easy to find the right vocabulary to describe a food experience in terms of sensory characteristics. According to Whorf (1956), language both reflects and determines the way in which we perceive the world. We do not all perceive the world in the same way, but rather view a world that has been organised by the linguistic system we use. Whorf (1956) used the example of the Eskimos, who use a more complex and precise vocabulary to describe snow, because the quality of the snow is essential for them. When it comes to food, and how we perceive its eating quality, we are likely to end up describing the food experience with more affective words such as “tasty,” “good,” “bad,” or “disgusting” (Civille and Lawless 1986); this may be one reason why it is often referred to as a “tip of the nose” phenomenon (Lawless and Engen 1977). However, referring to a product as “tasty” or “bad” may not be sufficient when marketing the product’s sensory characteristics to consumers and buyers. The research area of sensory science offers some ways to overcome this dilemma. Sensory science is a multidisciplinary field
comprising the measurement, interpretation, and understanding of human response to different products, in this case food products, including properties as perceived by the senses such as sight, hearing, touch, smell, and taste (Lawless and Heymann 1999). One of the primary roles of sensory science within the food industry is to provide relevant information about the sensory characteristics of a food product and its ingredients, and also related information such as perceived quality and consumers’ liking within the process of product development and the business decision of whether or not to launch a product (Moskowitz, Beckley, and Resurreccion 2006). As consumers become more demanding about the food they buy and consume, the sensory qualities of food products constitute an important and critical aspect for retailers and food companies.

The way in which we experience a sensory stimulus is determined by both bottom-up (experience, heuristics) and top-down (knowledge) processes. Bottom-up processes reflect the characteristics of the stimulus on the perceiver’s sensory organs, while top-down processes reflect the perceiver’s beliefs, desires, and expectations. Top-down processes can be further illustrated by, for example, Jastrow’s famous rabbit-duck illusion, which is perceived according not only to what the observer sees in the picture but also to what they expect to see; perception is a mental activity and not just a product of stimulus (Kilstrom 2002). Regarding this type of process, consumer testing of food and drink has shown that conceptual information about a product (e.g. brand and price) affects the subjective experience of the consumers and influences their choice of product. Sprott and Shimp (2004) proposed a theory of how consumers make quality judgments, as part of their study into the interaction of brand status (store brand, national brand) and quality of taste experience. Their theory was based on the judgment of inherent product features with intrinsic cues such as taste and extrinsic cues such as price, brand, and product information. When intrinsic cues can be evaluated, they tend to dominate over extrinsic cues.

This type of top-down processing when it comes to food and drinks in consumer testing has shown that conceptual information on subjective experience influences the consumer’s choice of product. A person’s expectation of a flavour or product is known to have an impact on their overall sensory perception of it (Cardello et al. 1985; Deliza and MacFie 1996; Schifferstein, Kole, and Mojet 1999). It has been shown in a number of studies that consumers struggle to choose their preferred product in blind taste tests where no brand cues (extrinsic) are given. In blind taste tests, consumers have to evaluate a product solely on their perceptions of the product’s intrinsic cues, such as taste, texture, or aroma. For example, McClure et al. (2004) revealed that consumers ranked Coca-Cola higher in a taste test when the logo was shown in comparison to when the logo was not shown. Similarly, Lee et al. (2006) found that consumers gave higher ratings to regular beer with a few added drops of balsamic vinegar when they did not know about the added vinegar, in comparison to consumers who were either not told about the vinegar at all or told about it immediately after tasting.

**Sensory Marketing Cues and Consumers’ Food Choices**

As every shopper knows, the appearance of the product and/or the package is often the only attribute that is used as a basis for the decision to purchase or consume a product. Hence, extrinsic prompts such as price tags, brand names, appearance, and quality labels are used mainly in situations where information on intrinsic cues is difficult to obtain (Holm and Kildevang 1996). How we perceive the appearance characteristics of a product is determined by different variables such as colour, size, shape, surface texture, clarity, and carbonation (for carbonated beverages) (Meilgaard, Civille, and Carr 2006). The appearance of a food product may be one of the first sensations a consumer perceives when making the decision of what product to choose, but it is also the first indicator of perceived quality in terms of taste (Lawless and Heymann 1999).
Consumers in low involvement situations will most probably use the extrinsic cues (e.g. brand name, price, and appearance) rather than intrinsic cues when making a product choice (Sprott and Shimp 2004). However, the appearance and colour of the food product will also capture the consumer’s attention, and thus induce some kind of expectation of the product (Hutchings 2003) which will also influence the consumer’s preference (Calvo, Salvador, and Susana 2001). Hoegg and Alba (2007b) demonstrated that the extrinsic cue of colour of a food product can influence how we think it tastes. When they used food colouring to change the colour of orange juice, the participants perceived differences in taste that did not actually exist. Conversely, the participants perceived no difference in taste between juice samples that were of the same colour but differed in that one had added sugar. The colour itself helps us as consumers to identify the product and tells us what to expect (DuBose, Castello, and Maller 1980). For example, the colour of a pepper (e.g. green, yellow, or red) helps us to determine what kind of pepper it is, how it will taste, and how strong the chilli flavour will be. Similarly, the colour of meat may help us determine how it is cooked (e.g. rare, medium, or well done), and describe the greatest variation in the material (Risvik 1994). This is the case even though the actual taste experience and colour are not always positively related; for example, apples do not necessarily taste better because they have a higher intensity of red colour (Long 1995).

Mitchell and Olson (1981), who compared visual versus verbal advertisements for tissues, found that a picture of a fluffy cat produced the strongest beliefs about the softness of the tissues. However, the participants in their study evaluated the products purely by watching the advertisements; in the present article, we suggest that consumers will change their choice when they see the product or evaluate the verbal label in relation to their taste preference.

The information that consumers face when making a choice may be processed in relation to different alternatives, with different attributes being considered one at a time and evaluated before another attribute is considered. For example, a consumer may first examine the price of the different products, and later relate the price to the actual quality of the product, eating quality in this case, in order to make a decision (Bettman et al. 1998). However, the choice of fast moving consumer goods will be affected by other external reference prices, as consumers make an explicit comparison of the stated price with other prices on shopping labels, tags, and so on (Biswas and Blair 1991). Still, price has shown to be less important as a quality cue when other quality cues, such as brand name or labelling, are present (Olson 1977). McKinnon et al. (1981) demonstrated an increase in sales resulting from signs with beneficial information about the product in retail stores. They also revealed that benefit signs should only be used for regular price over a no-sign condition, but when the products were on sale both price and benefit sign should increase sale. Doods et al. (1991) found that a higher price had a positive effect on the perceived quality of the product, but a negative effect on consumers' perceived value and willingness to buy the product. Consumers could use price as an indicator of the amount of sacrifice needed to purchase a product and an indicator of the level of quality. Fotopoulos and Krystallis (2003), who explored consumer willingness to pay for apples with a quality label indicating the geographic origin, found that consumers might be willing to pay a premium price for apples when a quality label was used instead of a commercial label. Similar results, again for apples, were also reported by McCluskey et al. (2007), who emphasized that the communication of a product's attributes will affect consumers' willingness to pay. They further highlighted that the closer the consumers come to their ideal of what they like about an apple, the more they are willing to pay.

Sensory descriptive labels have been shown in a number of studies to have a significant effect on sensory perception, preference, and consumer choice behaviour in relation to different food and drink products. Wansink et al. (2001; 2005) studied the effect of using sensory descriptive names for the food on the menu in a restaurant. Although their sensory descriptions could be considered fairly sparse in terms of providing additional information on sensory quality, for example simply adding the sensory attribute “Tender” to
“Grilled Chicken”, they found that the consumers were indeed affected. The sensory description labels had a positive effect both on sales and on the diners’ evaluations of the dishes; dishes with sensory description labels were rated higher in quality than those with regular labels.

Elder and Krishna (2010) found that multiple-sense advertisements for chewing gum (“Stimulate your senses”) resulted in consumers experiencing better taste perception and sensory thoughts in comparison to single-sense advertisements (“Long Lasting Flavour”). Their consumers also generated more positive thoughts when shown a multiple-sense advertisement for potato chips including sensory attributes such as flavour and texture.

It is important that the information on the labels is consistent with the consumer’s own sensory evaluation (Dimara and Skuras 2005). Wansink et al. (2000) demonstrated in a taste test that when the attribute “soy” was communicated on the packaging of nutrition bars, the consumers experienced the product as grainy, less flavourful, and having a strong aftertaste in comparison to bars in packaging which did not communicate the attribute “soy”. Swahn et al. (2011) reported similar results, with consumers reacting negatively to sensory description labels for apples including the word “perfume”. Moreover, Solomon (1990) and Lawless (1984) demonstrated how different groups (novices and experts) were able to match the information provided on sensory description labels with the perceived taste of different wines. They concluded that sensory description labels developed by an expert communicate more reliable information and are therefore easier to comprehend when matching the information provided with the perceived taste. Given this, Swahn et al. (2010) and Larsson and Swahn (2011) demonstrated how sensory description labels could be developed by combining sensory science and linguistics, in the form of semantic frame theory, when creating different sensory marketing labels for food products. They also highlighted the importance of using the right words when communicating the sensory qualities of food, both for informational and aesthetic reasons; for example, a term such as “tropical fruit” is quite ambiguous (ambiguous names are uninformative in general) and includes other subcategories such as “mango” and “passion fruit”.

However, even ambiguous product labels such as “passion blue,” “lucky brown,” and “snuggly white” have been shown to affect the consumer’s evaluation of the product; in a study by Miller and Kahn (2005), the consumers ascribed additional positive attributions to the product with a ambiguous name. This is consistent with the theory of “conversational implicature” (Grice 1975), which suggests that consumers will more or less rely on the company and markets to communicate reliable and useful product information. The theory states that consumers seem to fill in the missing information which is left out of the communication, and therefore seem to look for additional positive attributions when ambiguous names are communicated (Miller and Kahn 2005). Perceptual learning suggests that labels affect perceptual discrimination only after an initial learning phase in which the labels have been clearly associated with specific sensory values (Hoegg and Alba 2007a).

It has also been demonstrated that the number of words communicated can have both a positive and a negative effect on consumer behaviour. Swahn et al. (2011) showed that consumers may struggle with long sensory description labels when choosing food products in a grocery retail store. Wansink et al. (2004) suggested that shorter sensory descriptive labels are better for capturing the consumer’s attention, and it has also been reported by Hughson and Boakes (2002) that consumers may be better able to perceive taste in relation to the information provided when this information is given in the form of a shorter description. When it comes to choosing the number of words to use on a label, it should be borne in mind that human beings are quite limited in the amount of information that we can process in our working memory (Baars, Banks, and Newman 2003; Baddeley 1997); Miller (1994) demonstrated that we can only keep about seven chunks of information in working memory at any one time.
The saying “the proof of the pudding is in the eating” maybe tells us how we actually perceive taste, it may be argued that the optimal way for a consumer to evaluate the sensory quality of a food product is to taste the product (Sprott and Shimp 2004). However, although in-store sampling may be an effective promotion method (Chandon, Wansink, and Laurent 2000), it is not possible for a grocery retail store to provide this on a daily basis. Instead, we suggest a marketing strategy in which sensory description labels are used to emphasize the sensory marketing appeal of the product and to mediate what the consumers should expect of the product in terms of sensory quality. Specifically, we suggest that consumers will be affected by sensory description labels when choosing food products in a grocery retail store.

We formally propose that:

**H1:** Sensory description labels for food will affect consumers’ product choice in general.

**H2:** Consumers choice will be quite inconsistent with their choice for visual appearance versus taste preference and price.

**H3:** Sensory description labels (short or long descriptions) will affect consumers’ choice positively in relation to taste preference and price.

We tested our set of hypotheses in a series of three experiments, using three identical food products and designs throughout all the experiments.

**METHOD**

Based on a sensory analysis of tomatoes available in Sweden during a specific time period (Swahn et al. 2010), we chose three varieties (DASHER [DA], PLUM [PL], and CLASSIC [CL]) according to their sensory profiles. Specifically, the chosen tomatoes had sensory profiles which were distinct in terms of taste but not in terms of colour. All tomatoes were red. The vocabulary used for the sensory descriptions was developed according to the sensory analysis and semantic method described by Swahn et al. (2011), who used a trained sensory panel and a group of consumers to elicit a sensory vocabulary for this food product. We also applied the semantic frame theory developed by Larsson and Swahn (2011) for the purpose of creating sensory description labels for food products that can be used for marketing in the grocery retail store. Bearing in mind the theory of Wansink et al. (2004) concerning shorter and longer description labels, we used two different types of descriptive labels in the present study. The first type are referred to in this article as sensory description labels; they contained information about the product’s sensory characteristics such as odour, flavour, taste, and texture. We distinguish here between taste (sweet, sour, bitter, umami, acidic, and salt), which is perceived in the mouth, and flavour, which is perceived in the oro-nasal cavity. The second type of labels are referred to as unique selling point (USP) labels; these are abridged versions of the sensory description labels, including the most important sensory attributes based on the sensory analysis (see figure 1).

The tomatoes were priced in line with the same tomatoes that were for sale in the grocery retail store at the time, in order to eliminate any price biases between the survey and the tomatoes for sale in the store (see figure 1).

A station was set up within the fruit and vegetable department at the grocery retail store. The tomatoes were presented in baskets in front of each label, and were selected and matched by colour and size in order to
minimise any visual differences, since occasionally the greatest variation of the product occurs in its appearance (Risvik 1994). The baskets contained an even distribution by amount. The tomatoes were presented in the same order during the entire study, because of the impracticality of changing the presentation order. For the taste test, the tomatoes were cut into appropriate serving pieces, matched in size and appearance. Before the observations began, a trial experiment was conducted to detect and prevent any ambiguities.

**Design and Procedure**

Design and procedure were identical between the three experiments. The study took place over a three-day period in a major grocery retail store in Sweden, with a total of 1163 consumers divided into three experiments (consumers were 40% male; however, neither age nor gender is analysed further in this report). An observational survey was conducted with independent data between the experiments (visual appearance, USP label, and sensory description) and dependent data within each experiment (session) (Altman 1999). The aim was to study persistence and change in consumer choice between experiments and different sensory marketing cues, and so the consumers had to make three different choices in each experiment.

Consumers were observed in three major periods of the day (morning, afternoon, and evening), in order to reduce any possible biases due to shopping environment and age. Consumers were approached by the observer in the fruit and vegetable department of the store, and asked to participate in a study involving choice of product and taste preference for tomatoes. When a consumer agreed to participate, the observer welcomed and instructed them in the following order. **Session 1:** The participant was asked either to look at the tomatoes and make a choice according to their visual appeal (experiment one, though the tomatoes were displayed in all experiments), or to read and evaluate the different labels and make a choice on that basis (experiments two and three). **Session 2:** Next, the participant was asked to taste the tomatoes and state a taste preference (all experiments). **Session 3:** Finally, the price of each tomato was shown and the participant was asked to make a choice based on price (all experiments). The observer used a protocol sheet to document each consumer’s choice of tomato in each session, together with their age and gender. There were three assessment experiments in the study, and the consumers made three choices in each experiment (see figure 1).

Experiment one: Consumers (1) evaluated the visual appearance of the tomatoes and made a choice, (2) tasted the tomatoes and made a choice, and (3) evaluated the price and made a choice. Experiment two: Consumers (1) evaluated labels with a short sensory description including the unique selling points (USP) and made a choice, (2) tasted the tomatoes and made a choice, and (3) evaluated the price and made a choice. Experiment three: Consumers (1) evaluated labels with a sensory description and made a choice, (2) tasted the tomatoes and made a choice, and (3) evaluated the price and made a choice.
## FIGURE 1 OVERVIEW OF THE THREE SESSIONS IN THREE EXPERIMENTS

### Experiment one, N=388

<table>
<thead>
<tr>
<th>CLASSIC</th>
<th>PLUM</th>
<th>DASHER</th>
</tr>
</thead>
<tbody>
<tr>
<td>First choice</td>
<td>Visual appearance</td>
<td>Visual appearance</td>
</tr>
<tr>
<td>Second choice</td>
<td>Taste preference</td>
<td>Taste preference</td>
</tr>
<tr>
<td>Third choice</td>
<td>Price $2.90/ kg</td>
<td>Price $5.70/ kg</td>
</tr>
</tbody>
</table>

### Experiment two, N=386

<table>
<thead>
<tr>
<th>CLASSIC</th>
<th>PLUM</th>
<th>DASHER</th>
</tr>
</thead>
<tbody>
<tr>
<td>First choice</td>
<td>USP label</td>
<td>USP label</td>
</tr>
<tr>
<td></td>
<td>Faint odour</td>
<td>Smoky tomato odour</td>
</tr>
<tr>
<td></td>
<td>Juicy and jelly-like</td>
<td>Juicy</td>
</tr>
<tr>
<td></td>
<td>Paint with some sweetness</td>
<td>Paint with some sweetness</td>
</tr>
<tr>
<td>Second choice</td>
<td>Taste preference</td>
<td>Taste preference</td>
</tr>
<tr>
<td>Third choice</td>
<td>Price $2.90/ kg</td>
<td>Price $5.70/ kg</td>
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</tbody>
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### Experiment three, N=388

<table>
<thead>
<tr>
<th>CLASSIC</th>
<th>PLUM</th>
<th>DASHER</th>
</tr>
</thead>
<tbody>
<tr>
<td>First choice</td>
<td>Sensory description label</td>
<td>Sensory description label</td>
</tr>
<tr>
<td></td>
<td>Faint odour</td>
<td>Smoky tomato odour</td>
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<tr>
<td></td>
<td>Juicy and jelly-like</td>
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<tr>
<td></td>
<td>with a touch of berries and grassy tones</td>
<td>with some sweetness and acidity, some pepper and grassy tones</td>
</tr>
<tr>
<td>Second choice</td>
<td>Taste preference</td>
<td>Taste preference</td>
</tr>
<tr>
<td>Third choice</td>
<td>Price $2.90/ kg</td>
<td>Price $5.70/ kg</td>
</tr>
</tbody>
</table>
Data Analysis

Three varieties of tomatoes (DA, PL, and CL) were used in each experiment to generate categorical data. The consumers’ choices of tomato in the different experiments were described by means of bar charts indicating the median and quartiles (the 50th, 25th, and 75th centiles). The possible influences of the different variables on the consumers’ choice of tomato were evaluated in pairwise comparisons:

**Experiment one:** visual appearance versus taste, and taste versus price

**Experiment two:** USP labels versus taste, and taste versus price

**Experiment three:** sensory description versus taste, and taste versus price.

The frequency distributions of these paired data sets in contingency tables show the patterns of persistence and change in the consumers’ choices. This method allows us to evaluate the part of the observed change in the pattern both on a group and individual level. It also allows us to evaluate attributable to the group separately from any presence of individual heterogeneity in change of choice. To extend the analysis, we also conducted a t-test with significance set at p < .05 to clarify the differences between the consumers’ choices.

In the following section, we first present the frequency distributions of the consumers’ initial choice of tomatoes in each experiment; that is, their choices on the basis of solely the visual appearance, the USP labels, and the sensory description labels, respectively (independent data). Next we present each experiment separately and analyze how these initial choices persisted or altered as the consumers were allowed to assess the taste and then the price of the tomatoes (dependent data).

RESULTS AND DISCUSSION

This section first presents the frequency distributions of the preferred tomatoes according to visual appearance, sensory descriptions, and USP labels in the different experiments. The second part presents the persistence and change in the consumers’ choice of tomatoes within each experiment (first, second, and third) and for each variable.

Overview of the Experiments: Choice of Tomato Between Experiments

**Results.** The frequency distributions of initial tomato choice in the different experiments are shown as bar charts in order to allow visualization of the rankings of the most frequently chosen tomato in each experiment according to (E1) visual appearance, (E2) USP, and (E3) sensory description (figure 2).

Figure 2 shows that in the first experiment (E1), when the consumers had only the visual appearance to help them evaluate the products and make a choice, 61% of the 389 consumers chose DA, 21% chose PL, and 18% chose CL. In experiment two (E2), when shorter sensory descriptions (USP labels) were shown, 76% of the 386 consumers chose DA, 14% chose PL, and 10% chose CL. Experiment three (E3), which used extended sensory description labels with sensory semantic descriptions, revealed results quite similar to those in experiment two; 76% of the 388 consumers chose DA, 17% chose PL, and 8% chose CL.
To extend the analysis of figure 2, we also conducted a t-test with significance set at $p < .05$ to investigate the differences between tomato varieties and experiments (see table 1).

A comparison of the experiments shows that the consumers preferred the DA tomato overall. DA was chosen with the highest frequency in all three experiments, and PL was chosen with the second highest frequency.

As seen in figure 2, DA was chosen with a relatively high frequency when the consumers made their choice by evaluating the visual appearance. A comparison of the experiments shows that the consumers were more likely to choose DA when the sensory characteristics were communicated via either USP labels or sensory description labels, than when they only had visual appearance to go on ($p < .01$).

PL scored the second highest frequency in all three experiments. A comparison of the experiments shows that this tomato was chosen with the highest frequency on visual appearance alone, and the frequency of choice decreased when USP labels were shown ($p < .03$). There were no significant differences in choice frequency when comparing the USP labels with the sensory description labels. The CL tomato was chosen with the lowest frequency in all three experiments. By comparing the experiments, we see that CL was chosen with the highest frequency when consumers saw only the visual appearance, and was less popular when USP labels ($p < .01$) and sensory description labels ($p < .01$) were shown, with no significant difference between USP label and sensory description labels (table 1).

**TABLE 1**

<table>
<thead>
<tr>
<th></th>
<th>E1 &amp; E2 (visual appearance vs. USP label)</th>
<th>E2 &amp; E3 (USP label vs. sensory description)</th>
<th>E1 &amp; E3 (visual appearance vs. sensory description)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>P-value</strong></td>
<td>$p &lt; .01$</td>
<td>$p &gt; .448$</td>
<td>$p &lt; .01$</td>
</tr>
<tr>
<td><strong>DASHER</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>PLUM</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>CLASSIC</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Discussion. By comparing the experiments (E1; visual appearance, E2; USP labels, and E3; sensory description labels) we found support for our hypothesis, H1, that sensory description labels for food will affect consumers’ choice behaviour. These results are consistent with previous results reported by Swahn et al. (2011), Wansink et al. (2001; 2005), and Lockshin et al. (2009). We found no significant differences between the choice behaviour of consumers shown longer or shorter labels. However, it has been suggested that a shorter sensory description may be better able to capture the attention of the consumer, and that a longer, extended version is best placed on the back of the product (Wansink et al. (2004). This is an essential aspect to consider, especially when consumers face a large number of products and a large amount of information to interpret and evaluate when choosing food products in the grocery retail store, since our working memory is quite limited (Baars 1997; Baddeley 1997). The design of the label and the number of words used may therefore be crucial in trying to draw the attention of the consumer. This type of argument also corresponds with the decision strategies used by consumers (Bettman et al. 1998); for example different sensory attributes may vary in desirability to the consumers which may affect how they are willing to trade off different attributes in order to choose a product.

One overall observation by the interviewers was that the consumers tended to be less interested in making their choice when only the appearance of the product was presented; their decision-making process in this case was quite fast compared to when the sensory description labels were presented in E2 and E3. This might be related to the fact as highlighted by Bettman, Luce, and Payne (1998) that consumers’ decisions are often developed “on the fly” and are therefore situation dependent; their decisions may change when they obtain more knowledge and information about the problem. In this case, the sensory descriptions labels were something new and interesting which they were not used to seeing in a normal grocery retail store. Furthermore, tomatoes are normally presented in the store along with a price label, and the consumers will eventually eat and hence taste the product, and therefore it would be of interest to investigate how these different variables could further affect their choice behaviour after they have already evaluated the sensory description labels and appearance. To answer this question, and to test our second and third hypotheses, we now analyze the three experiments separately.
FIGURE 2
CUMULATIVE PERCENTAGE FREQUENCY HISTOGRAM SHOWING CONSUMER CHOICE OF TOMATO (%) FOR EACH TOMATO AND EXPERIMENT; (E1) VISUAL APPEARANCE, (E2) USP, AND (E3) SENSORY DESCRIPTIONS.

To extend the analysis of figure 2, we also conducted a t-test with significance set at p < .05 to investigate the differences between tomato varieties and experiments (see table 1).

A comparison of the experiments shows that the consumers preferred the DA tomato overall. DA was chosen with the highest frequency in all three experiments, and PL was chosen with the second highest frequency.

As seen in figure 2, DA was chosen with a relatively high frequency when the consumers made their choice by evaluating the visual appearance. A comparison of the experiments shows that the consumers were more likely to choose DA when the sensory characteristics were communicated via either USP labels or sensory description labels, than when they only had visual appearance to go on (p < .01).

PL scored the second highest frequency in all three experiments. A comparison of the experiments shows that this tomato was chosen with the highest frequency on visual appearance alone, and the frequency of choice decreased when USP labels were shown (p < .03). There were no significant differences in choice frequency when comparing the USP labels with the sensory description labels. The CL tomato was chosen with the lowest frequency in all three experiments. By comparing the experiments, we see that CL was chosen with the highest frequency when consumers saw only the visual appearance, and was less popular when USP labels (p < .01) and sensory description labels (p < .01) were shown, with no significant difference between USP label and sensory description labels (table 1).

TABLE 1
COMPARISON OF THE DIFFERENCES OF PERCENTAGE (FIGURE 2) BETWEEN EXPERIMENTS AND SAMPLES

<table>
<thead>
<tr>
<th></th>
<th>E1 &amp; E2 (visual appearance vs. USP label)</th>
<th>E1 &amp; E3 (visual appearance vs. sensory description)</th>
<th>E2 &amp; E3 (USP label vs. sensory description)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>P-value</td>
<td>P-value</td>
<td>P-value</td>
</tr>
<tr>
<td>DASHER</td>
<td>p &lt; .01</td>
<td>p &lt; .01</td>
<td>p &gt; .448</td>
</tr>
<tr>
<td>PLUM</td>
<td>p &lt; .03</td>
<td>p &gt; .06</td>
<td>p &gt; .121</td>
</tr>
<tr>
<td>CLASSIC</td>
<td>p &lt; .01</td>
<td>p &lt; .01</td>
<td>p &gt; .095</td>
</tr>
</tbody>
</table>

Discussion. By comparing the experiments (E1; visual appearance, E2; USP labels, and E3; sensory description labels) we found support for our hypothesis, H1, that sensory description labels for food will affect consumers’ choice behaviour. These results are consistent with previous results reported by Swahn et al. (2011), Wansink et al. (2001; 2005), and Lockshin et al. (2009). We found no significant differences between the choice behaviour of consumers shown longer or shorter labels. However, it has been suggested that a shorter sensory description may be better able to capture the attention of the consumer, and that a longer, extended version is best placed on the back of the product (Wansink et al. 2004). This is an essential aspect to consider, especially when consumers face a large number of products and a large amount of information to interpret and evaluate when choosing food products in the grocery retail store, since our working memory is quite limited (Baars 1997; Baddeley 1997). The design of the label and the number of words used may therefore be crucial in trying to draw the attention of the consumer. This type of argument also corresponds with the decision strategies used by consumers (Bettman et al. 1998); for example different sensory attributes may vary in desirability to the consumers which may affect how they are willing to trade off different attributes in order to choose a product. One overall observation by the interviewers was that the consumers tended to be less interested in making their choice when only the appearance of the product was presented; their decision-making process in this case was quite fast compared to when the sensory description labels were presented in E2 and E3. This might be related to the fact as highlighted by Bettman, Luce, and Payne (1998) that consumers’ decisions are often developed “on the fly” and are therefore situation dependent; their decisions may change when they obtain more knowledge and information about the problem. In this case, the sensory descriptions labels were something new and interesting which they were not used to seeing in a normal grocery retail store. Furthermore, tomatoes are normally presented in the store along with a price label, and the consumers will eventually eat and hence taste the product, and therefore it would be of interest to investigate how these different variables could further affect their choice behaviour after they have already evaluated the sensory description labels and appearance. To answer this question, and to test our second and third hypotheses, we now analyze the three experiments separately.
Experiment One: Visual Appearance Versus Taste Preference, and Taste Preference Versus Price

In this experiment, we observed the consumers’ choice behaviour according to visual appearance, taste, and price, allowing us to compare visual appearance versus taste preference and taste preference versus price (hypothesis H2). These are variables which are commonly available in grocery retail stores; our hypothesis was that even at this level, the consumers would change their choices depending on which of the variables they were allowed to base their decision on. We considered this was a suitable way to gain an initial idea, to serve as a benchmark, of consumer choice behaviour without any additional advertisements or sensory description labels.

Results. A total of 389 consumers participated in this experiment. We analyzed their choice behaviour in terms of visual appearance versus taste preference, and taste versus price. After evaluating the visual appearance of the tomatoes, 61% of the consumers chose DA; after tasting the tomatoes, 79% chose DA; and after evaluating the price, 41% chose DA and 45% chose CL (figure 3).

**FIGURE 3**
EXPERIMENT ONE: CONSUMERS’ CHOICE OF TOMATOES (%) FOR EACH TOMATO AND SESSION.

<table>
<thead>
<tr>
<th></th>
<th>CLASSIC</th>
<th>PLUM</th>
<th>DASHIER</th>
</tr>
</thead>
<tbody>
<tr>
<td>DA</td>
<td>207</td>
<td>56</td>
<td>43</td>
</tr>
<tr>
<td>PL</td>
<td>16</td>
<td>18</td>
<td>2</td>
</tr>
<tr>
<td>CL</td>
<td>15</td>
<td>7</td>
<td>25</td>
</tr>
<tr>
<td>Total</td>
<td>306</td>
<td>36</td>
<td>47</td>
</tr>
</tbody>
</table>

Discussion. In the first experiment, we found support for hypothesis H2; consumers’ choice will be quite inconsistent with their choice for visual appearance versus taste preference and price. When we compared the choices made by the consumers after inspecting the apples visually and after tasting them, the results indicated that 64% of the consumers made the same choice of product for visual appearance and taste. However, a large group of consumers were influenced by taste, and changed their minds after tasting the products. This is in accordance with previous research showing that colour and appearance do have an impact on consumers’ choices (Risvik, 1994), preference (Calvo et al., 2001), and perceived taste (Hoegg and Alba, 2007b). This relationship may be ambiguous; for example, colour could act as either an extrinsic or an intrinsic cue, a phenomenon which could be discussed in the light of the present results, where consumers actually changed their minds due to taste preference (an intrinsic cue). However, colour and visual appearance are important variables for consumer choice of food products (DuBose et al. 1980; Risvik 1994), and important factors for grocery retail stores to embrace.

Only 58% of the consumers persisted in their choice of tomato when the price was communicated; 41% changed to a cheaper variety. Even though the consumers made a choice based on the intrinsic cue of taste, price then overruled this variable, leading them to choose a cheaper tomato. However, tomatoes may be considered as a low involvement product, which could mean that other variables, such as price in this case, are more important when making a choice (Sprott and Shimp, 2004). In this experiment, the consumers were not given any additional information about the tomatoes, which has been discussed as a factor capable of affecting consumer choice behaviour in relation to price (McKinnon et al. 1981). Moreover, consumers are not usually able to taste the product before making a choice. The results of experiment one indicate that although the

*Visual appearance versus taste.* The observed pattern of persistence and change in the consumers' choice of tomatoes between the vision and taste sessions is shown in figure 4a. The main diagonal of unchanged categories from the lower-left to the upper-right corner shows that 64% of the consumers did not change their choice between the two sessions. DA was chosen by 207 consumers ($p < .05$) in both sessions, and an additional 99 ($p < .05$) switched to DA after the taste test, while 31 changed from DA to either PL or CL after tasting.
**Experiment One: Visual Appearance Versus Taste Preference, and Taste Preference Versus Price**

In this experiment, we observed the consumers’ choice behaviour according to visual appearance, taste, and price, allowing us to compare visual appearance versus taste preference and taste preference versus price (hypothesis H2). These are variables which are commonly available in grocery retail stores; our hypothesis was that even at this level, the consumers would change their choices depending on which of the variables they were allowed to base their decision on. We considered this was a suitable way to gain an initial idea, to serve as a benchmark, of consumer choice behaviour without any additional advertisements or sensory description labels.

**Results.**

A total of 389 consumers participated in this experiment. We analyzed their choice behaviour in terms of visual appearance versus taste preference, and taste versus price. After evaluating the visual appearance of the tomatoes, 61% of the consumers chose DA; after tasting the tomatoes, 79% chose DA; and after evaluating the price, 41% chose DA and 45% chose CL (figure 3).

**FIGURE 3**

**EXPERIMENT ONE: CONSUMERS’ CHOICE OF TOMATOES (%) FOR EACH TOMATO AND SESSION.**

**Visual appearance versus taste.** The observed pattern of persistence and change in the consumers’ choice of tomatoes between the vision and taste sessions is shown in figure 4a. The main diagonal of unchanged categories from the lower-left to the upper-right corner shows that 64% of the consumers did not change their choice between the two sessions. DA was chosen by 207 consumers (p < .05) in both sessions, and an additional 99 (p < .05) switched to DA after the taste test, while 31 changed from DA to either PL or CL after tasting.

**Taste versus price.** The observed pattern of persistence and change in the choice of tomatoes between the taste and price sessions is shown in figure 4b. The main diagonal of unchanged categories from the lower-left to the upper-right corner shows that 58% of the consumers did not change their choice between the two sessions. DA was chosen by 156 consumers (p < .05) in both sessions; 27 consumers changed from DA to PL and an additional 123 (p < .05) from DA to CL.

**FIGURE 4 (a & b)**

THE OBSERVED PATTERN OF PERSISTENCE IN CHOICE OF TOMATOES FOR 389 CONSUMERS

<table>
<thead>
<tr>
<th></th>
<th>Vision (X)</th>
<th></th>
<th>Taste (Y)</th>
<th></th>
<th>Price (Z)</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>DA</td>
<td>PL</td>
<td>CL</td>
<td>Total(yi)</td>
<td>DA</td>
<td>PL</td>
</tr>
<tr>
<td>CL</td>
<td>15</td>
<td>7</td>
<td>25</td>
<td>47</td>
<td>123</td>
<td>8</td>
</tr>
<tr>
<td>PL</td>
<td>16</td>
<td>18</td>
<td>2</td>
<td>36</td>
<td>27</td>
<td>25</td>
</tr>
<tr>
<td>DA</td>
<td>207</td>
<td>56</td>
<td>43</td>
<td>306</td>
<td>156</td>
<td>3</td>
</tr>
<tr>
<td>Total(xi)</td>
<td>238</td>
<td>81</td>
<td>70</td>
<td>389</td>
<td>306</td>
<td>36</td>
</tr>
</tbody>
</table>

**Discussion.** In the first experiment, we found support for hypothesis H2; consumers choice will be quite inconsistent with their choice for visual appearance versus taste preference and price. When we compared the choices made by the consumers after inspecting the apples visually and after tasting them, the results indicated that 64% of the consumers made the same choice of product for visual appearance and taste. However, a large group of consumers were influenced by taste, and changed their minds after tasting the products. This is in accordance with previous research showing that colour and appearance do have an impact on consumers’ choices (Risvik, 1994), preference (Calvo et al., 2001), and perceived taste (Hoegg and Alba, 2007b). This relationship may be ambiguous; for example, colour could act as either an extrinsic or an intrinsic cue, a phenomenon which could be discussed in the light of the present results, where consumers actually changed their minds due to taste preference (an intrinsic cue). However, colour and visual appearance are important variables for consumer choice of food products (DuBose et al. 1980; Risvik 1994), and important factors for grocery retail stores to embrace.

Only 58% of the consumers persisted in their choice of tomato when the price was communicated; 41% changed to a cheaper variety. Even though the consumers made a choice based on the intrinsic cue of taste, price then overruled this variable, leading them to choose a cheaper tomato. However, tomatoes may be considered as a low involvement product, which could mean that other variables, such as price in this case, are more important when making a choice (Sprott and Shimp, 2004). In this experiment, the consumers were not given any additional information about the tomatoes, which has been discussed as a factor capable of affecting consumer choice behaviour in relation to price (McKinnon et al. 1981). Moreover, consumers are not usually able to taste the product before making a choice. The results of experiment one indicate that although the
consumers were willing to change their choice according to the perceived taste of the product, they were not willing to pay a higher price solely on the basis of taste; this may indicate that they need additional information about the product to actually make a proper choice. Experiments two and three aimed to investigate consumer choice behaviour in relation to different sensory description labels.

Experiment Two: USP Labels Versus Taste Preference, and Taste Preference Versus Price

In this experiment, we aimed to compare USP labels versus taste preference, and taste preference versus price (hypothesis H3). The USP labels used in this experiment were shorter versions of the sensory description labels, developed by the same method and procedure as Swahn et al. (2010). They included only the most relevant attributes for the sensory character of the tomatoes (figure 1). The consumers in this experiment were also able to inspect the visual appearance of the tomatoes.

Results. A total of 386 consumers participated in this experiment. We analyzed their choice behaviour in terms of USP labels versus taste preference, and taste versus price. After evaluating the USP labels, 76% of the consumers chose DA; after tasting the tomatoes, 79% chose DA; and after evaluating the price, 50% chose DA and 32% chose CL (figure 5).

USP labels versus taste. The observed pattern of persistence and change in the consumers’ choice of tomatoes between the USP labels and taste sessions is shown in figure 6a. The main diagonal of unchanged categories from the lower-left to the upper-right corner shows that 75% of the consumers did not change their choice between the two sessions. DA was chosen by 257 consumers (p < .05) in both sessions, and an additional 47 (p < .05) switched to DA after evaluating the labels, while another 37 changed from DA to either PL or CL.
Consumers were willing to change their choice according to the perceived taste of the product, they were not willing to pay a higher price solely on the basis of taste; this may indicate that they need additional information about the product to actually make a proper choice. Experiments two and three aimed to investigate consumer choice behaviour in relation to different sensory description labels.

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Results.

A total of 386 consumers participated in this experiment. We analyzed their choice behaviour in terms of USP labels versus taste preference, and taste versus price. After evaluating the USP labels, 76% of the consumers chose DA; after tasting the tomatoes, 79% chose DA; and after evaluating the price, 50% chose DA and 32% chose CL (figure 5).

FIGURE 5
EXPERIMENT TWO: CONSUMERS’ CHOICE OF TOMATOES (%) FOR EACH TOMATO AND SESSION.

USP labels versus taste.

The observed pattern of persistence and change in the consumers’ choice of tomatoes between the USP labels and taste sessions is shown in figure 6a. The main diagonal of unchanged categories from the lower-left to the upper-right corner shows that 75% of the consumers did not change their choice between the two sessions. DA was chosen by 187 consumers (p < .05) in both sessions; after evaluating the price, 31 consumers changed from DA to PL and an additional 86 from DA to VA (p < .05).

Taste versus price.

The observed pattern of persistence and change in the choice of tomatoes between taste and price sessions is shown in figure 6b. The main diagonal of unchanged categories from the lower-left to the upper-right corner shows that 66% of the consumers did not change their choice between the two sessions. DA was chosen by 187 consumers (p < .05) in both sessions; after evaluating the price, 31 consumers changed from DA to PL and an additional 86 from DA to VA (p < .05).

FIGURE 6 (a & b)
THE OBSERVED PATTERN OF PERSISTENCE IN CHOICE OF TOMATOES FOR 386 CONSUMERS

Discussion.

The results of experiment two support our hypothesis (H3) that the USP labels would affect the consumers’ choice behaviour. The level of agreement in choice between taste preference and price was quite high in general. The USP labels appear to have had a positive effect on consumer choice behaviour; 75% of the consumers stayed with the same choice after tasting the product, which could be interpreted as meaning that the description was congruent with the perceived taste. This is quite an interesting result, and suggests a way to influence consumers towards making a more conscious choice of food in the grocery retail store. There was also fairly high agreement between the consumers’ choices on the basis of taste and price; 66% chose the same tomato for taste and price, and only 33% changed to a cheaper tomato when price was communicated. This indicates that consumers may be willing to pay a higher price for tomatoes with a sensory description label, in this case a shorter version communicating the most important attributes (USP). The question remains of how a longer and more detailed sensory description will affect the consumers’ choice behaviour. In experiment three, we address this question and try to answer the same hypothesis (H3) as in experiment tw.
Experiment Three: Sensory Description Versus Taste Preference, and Taste Preference Versus Price

Given the results of the second experiment, the third experiment set out to study whether a longer and more thorough sensory description label had a similar affect on consumer choice behaviour in relation taste preference and price (hypothesis H3). We posit that the results will be similar to those in experiment two, with even the longer and more thorough sensory description labels affecting the consumers choice positively in relation to taste preference and price.

Results. A total of 388 consumers participated in this experiment. We analyzed their choice behaviour in terms of sensory descriptions versus taste preference, and taste versus price. After evaluating the sensory description labels, 76% of the consumers chose DA; after tasting the tomatoes, 79% chose DA; and after evaluating the price, 50% chose DA and 29% chose CL (figure 7).

<table>
<thead>
<tr>
<th></th>
<th>Experiment two: Consumers' choice of tomatoes (%) for each tomato and session.</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Sensory description</td>
</tr>
<tr>
<td>CL</td>
<td>21</td>
</tr>
<tr>
<td>PL</td>
<td>17</td>
</tr>
<tr>
<td>DA</td>
<td>256</td>
</tr>
<tr>
<td>Total</td>
<td>308</td>
</tr>
</tbody>
</table>

Discussion. The results of experiment three add further support to our third hypothesis (H3). They also help to establish the potential of using sensory description labels as a marketing tool for food products, and show how these labels can affect consumer choice behaviour in relation to taste preference and price.

The use of sensory description labels in experiment three led to 74% of consumers persisting in their initial choice of product even after tasting the tomatoes; a similar result to that in experiment two. There was also good agreement between taste preference and price preference; 67% of the consumers made the same choice for taste and price, with only 32% changing to a cheaper tomato, a result again similar to the result in experiment two. These results give us some hints about how grocery retail stores could market their products in order to affect consumer choice behaviour. As mentioned above, sensory descriptions are not generally used in advertisements for food products, in the way that the labels in the present article were designed according to the products' sensory characteristics based on a sensory analysis. It has also been argued that sensory description labels developed by experts—or, as in this case, a trained sensory panel—may come closer to the perceived taste experience (Lawless 1984; Solomon 1990). In terms of sensory description labels in a grocery retail store, consumers would probably not be able to remember all the information on the label; however, if the sensory description labels are placed on the package, which the consumer will take home with them, this will allow them to evaluate the label according to perceived taste. This type of relationship may be relevant when it comes to repurchase and consumer satisfaction.
between the two sessions. DA was chosen by 191 consumers ($p < .05$) in both sessions; after evaluating the price, 42 consumers changed from DA to PL and an additional 75 from DA to CL ($p < .05$).

**FIGURE 8 (a & b)**

THE OBSERVED PATTERN OF PERSISTENCE IN CHOICE OF TOMATOES FOR 388

(a)

<table>
<thead>
<tr>
<th>Sensory description (X)</th>
<th>DA</th>
<th>PL</th>
<th>CL</th>
<th>Total($y_i$)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Taste (Y)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CL</td>
<td>21</td>
<td>3</td>
<td>11</td>
<td>35</td>
</tr>
<tr>
<td>PL</td>
<td>17</td>
<td>22</td>
<td>6</td>
<td>45</td>
</tr>
<tr>
<td>DA</td>
<td>256</td>
<td>39</td>
<td>13</td>
<td>308</td>
</tr>
<tr>
<td>Total($x_i$)</td>
<td>294</td>
<td>64</td>
<td>30</td>
<td>388</td>
</tr>
</tbody>
</table>

(b)

<table>
<thead>
<tr>
<th>Taste (Y)</th>
<th>DA</th>
<th>PL</th>
<th>CL</th>
<th>Total($y_i$)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Price (Z)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CL</td>
<td>75</td>
<td>6</td>
<td>33</td>
<td>114</td>
</tr>
<tr>
<td>PL</td>
<td>42</td>
<td>36</td>
<td>1</td>
<td>79</td>
</tr>
<tr>
<td>DA</td>
<td>191</td>
<td>3</td>
<td>1</td>
<td>195</td>
</tr>
<tr>
<td>Total($x_i$)</td>
<td>308</td>
<td>45</td>
<td>35</td>
<td>388</td>
</tr>
</tbody>
</table>

**Discussion.** The results of experiment three add further support to our third hypothesis (H3). They also help to establish the potential of using sensory description labels as a marketing tool for food products, and show how these labels can affect consumer choice behaviour in relation to taste preference and price. The use of sensory description labels in experiment three led to 74% of consumers persisting in their initial choice of product even after tasting the tomatoes; a similar result to that in experiment two. There was also good agreement between taste preference and price preference; 67% of the consumers made the same choice for taste and price, with only 32% changing to a cheaper tomato, a result again similar to the result in experiment two. These results give us some hints about how grocery retail stores could market their products in order to affect consumer choice behaviour. As mentioned above, sensory descriptions are not generally used in advertisements for food products, in the way that the labels in the present article were designed according to the products’ sensory characteristics based on a sensory analysis. It has also been argued that sensory description labels developed by experts — or, as in this case, a trained sensory panel — may come closer to the perceived taste experience (Lawless 1984; Solomon 1990). In terms of sensory description labels in a grocery retail store, consumers would probably not be able to remember all the information on the label; however, if the sensory description labels are placed on the package, which the consumer will take home with them, this will allow them to evaluate the label according to perceived taste. This type of relationship may be relevant when it comes to repurchase and consumer satisfaction.
GENERAL DISCUSSION

Our hypotheses were supported across three experiments, demonstrating that both short (USP) and long sensory description labels can affect consumer choice behaviour in relation to taste preference and price when making a food choice in a grocery retail store.

This study aimed to widen the research on sensory perception within marketing, which has previously been focused primarily on vision and hearing, though increasing attention is now being paid to other senses such as taste (Krishna 2010; Peck and Childers 2008). We also aimed to combine different methods and theories from sensory analysis and consumer behaviour when creating different food labels within the field of sensory marketing, by showing how different marketing cues (sensory description labels, visual appearance, taste, and price) for food products can affect consumer food choice behaviour in a grocery retail store. We investigated the relationship between different choices and with different variables, in order to analyze patterns of persistence and change in consumers’ choice behaviour. Taste preference was used as the main variable, to reveal how consumers are affected by different intrinsic and extrinsic cues when making a choice.

One of the more interesting findings was that USP labels and sensory description labels showed similar effects in relation to taste preference; experiments two and three indicated between-session agreement of 75% and 74% respectively. The results could be further discussed in relation to the theory of the perceiver’s belief, desires, and expectations (top-down process), and the idea that after the consumers interpret the sensory description labels, they have some kind of knowledge and beliefs regarding the product, which might affect their taste preference. In this case, it could also be assumed that the label information (sensory description) is relatively accurate in relation to the perceived taste experience according to a relatively high agreement in E2 and E3, which is a key factor when using this kind of marketing strategy (Hoegg and Alba 2007a; Wansink et al. 2000). This is also supported by the theory of Grice (1975), who pointed out that it is important for companies to use accurate information, as consumers will trust the label information provided by a company. Therefore it could be further argued as a relevant approach to combine the method and theories within sensory science when developing sensory ads for food product to be able to use accurate description according to perceived taste.

The price differences for the products were quite large. It could be argued that if more similar price levels had been compared, for example varying by only about 10-25%, the outcome might have been different. However, the results still give us some hints about consumer choice behaviour for food products with sensory description labels in relation to price. Our results are also consistent with the discussion by Olson (1977), who argued that an extra cue, such as information labels (sensory descriptions), will affect consumers’ price sensitivity positively, in this case meaning that they choose a more expensive product. This interaction between sensory description labels and price needs to be further investigated for different food products. For example, tomatoes are considered as seasonal and the price may vary between different times of the year, while apples such as Granny Smith will not vary much in price due to the fact that they have a relatively long season. It is vital for marketers and retailers to be aware of the relationship between perceived taste and what the consumer is willing to pay.

However, it should be remembered that sensory description labels, for example tomatoes, are not currently in widespread use in the fresh fruit sector in grocery retail stores. Therefore, an efficient marketing strategy is required in order to familiarise consumers with the different varieties and guide the consumers in their choice and ensure that they will purchase them again. Our research reveals some practical implications for marketers, advertisers, and sensory staff. First, we have shown that sensory description labels can affect consumer choice behaviour when it comes to food products. More specifically, we have demonstrated that sensory description labels have a positive effect on consumers’ taste preference, and that when sensory description labels are used, consumers are more likely to make a more proper food choice in relation to the perceived taste experience.
Second, we have shown that sensory description labels have a positive affect on consumers’ willingness to pay a higher price when the quality of the food product is communicated. Finally, we have shown the value of combining sensory analysis and consumer behaviour when developing sensory advertisements for food.

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