Unpacking the language of taste

— A study of gustatory descriptions in Swedish laypeople and trained experts.

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Abstract

Eating and drinking evoke complex sensory experiences and articulating them through language is often challenging. Differences between laypeople and sensory experts may offer valuable insights into how gustatory experiences are communicated. This study examines how expertise shapes flavor descriptions, focusing on *linguistic codability*. By analyzing elicited descriptions of gustatory stimuli from Swedish laypeople and sensory experts, differences in lexical precision, agreement, and differentiation in gustatory language are investigated. The results show that experts exhibit greater lexical precision and a broader vocabulary. However, both groups show comparable agreement in basic taste identification with no significant differences in response time. The findings indicate that even though experts exhibit a broader and more precise vocabulary, similarities between the groups and variation within both groups might suggest that linguistic encoding of flavor is influenced not only by expertise, but also by individual factors. These findings deepen our understanding of how language represents sensory experience and how differences in expertise impact the way we talk about flavor.

Table of contents

1. Introduction

Every sensation includes a seed of dream or depersonalization

— Maurice Merleau-Ponty

The connection between speaking and eating is old and profound. The use of language is deeply entangled with the ritual of sharing a meal. This is a historical and evolutionary fact, but as Dunbar (2017: 198) states, it is also proven that: "those who eat socially more often feel happier and are more satisfied with life, are more trusting of others, are more engaged with their local communities, and have more friends they can depend on for support.". Thus, speaking and eating seems to be heavily grounded in human social behavior.

If eating and speaking are so deeply connected, why is describing flavor still so difficult? Compared to sight and hearing, describing gustatory experiences is known to be particularly challenging for English-speaking Westerners (Majid et al. 2018; Levinson & Majid 2014). Despite this, gustatory language is an integral part of daily life in modern Western society, largely due to the marketing and promotion of food products. Commercial taste descriptions are often developed with the help of sensory experts, as experts are more skilled at differentiating and describing tastes and aromas (Lawless & Heymann 2010: 5–10). At the same time, effective communication between sensory experts and laypeople depends on creating a shared language for describing flavor. The specialized vocabulary used by sensory experts may not always align with the ways in which laypeople describe flavor. Investigating these differences sheds light on the mechanisms behind gustatory language and its accessibility to non-experts. This study seeks to map out differences between experts and laypeople in their ability to produce descriptions of gustatory stimuli. In light of global challenges such as malnutrition, obesity, and sustainability, a deeper understanding of gustatory language may play a role in shaping the future of food development.

The contrast between laypeople and experts in gustatory descriptions has received limited attention in linguistics. A notable study by Croijmans and Majid (2016), conducted in Dutch, investigated differences in language use between wine and coffee experts and laypeople, finding only marginal differences between the groups. Drawing on this research, the current study conducted an experiment with Swedish participants, following a similar approach. Both trained sensory experts and laypeople were asked to describe gustatory stimuli as precisely as possible. The collected data were analyzed using an adapted version of the *codability* measure developed by Brown &

Lenneberg (1954) in their typological work on color terms. Codability describes how easily people can put a concept, object, or experience into words, depending on how available, simple and clear the descriptions are in their language. This measure was applied by Majid & Burenhult (2014), Croijmans & Majid (2016) and Majid et al. (2018) for assessing descriptive proficiency in all sensory domains.

1.1 Research questions

The central research question of the thesis could be formulated as:

- Do trained experts and laypeople differ in codability when describing gustatory experiences?

This question is further refined through the following specific sub-questions. A more detailed description of these questions and how the current study operated the codability measure is found in Section 3.4.1.

1. Do the different groups show a significant difference in their use of semantic categories?
2. Do the different groups show a significant difference in answering length?
3. Do the different groups show a significant difference in answering precision?
4. Do the different groups show a significant difference in agreement?
5. Do the different groups show a significant difference in target response time?

To further explore why such differences might arise, specific attention is drawn to the Grounded Cognition Model (GCM), a prominent theory in psycholinguistics that suggests a neurological connection between language, cognition and sensory experience. In order to address this theory more specifically, not only gustatory stimuli (foods and drinks) were used to elicit gustatory descriptions, but also visual stimuli (images of food products). By bridging these approaches, I seek to provide a nuanced and broad understanding of how experts and laypeople encode gustatory experiences.

Section 2 provides the theoretical background, introducing the challenges of defining taste and flavor, presenting the Grounded Cognition Model as well as previous linguistic research in the gustatory domain and the objectives of the current study. Section 3 thoroughly explains the data collection and analysis used for the experiment. Section 4 presents the results of the experiment, which are then discussed in Section 5 in relation to the theories introduced in Section 2. Finally, Section 6 summarizes the conclusions drawn from the discussion and suggests potential directions for future research.

2. Theoretical background

Section 2.1 presents some basic issues concerning taste anatomy, semantic meaning and lexical ambiguity in the gustatory domain. 2.2 contains a theoretical overview of the Grounded Cognition Model. 2.3 presents a background of the codability measure by reviewing previous typological linguistic research in the sensory field. 2.4 summarizes and presents the objectives of the current study.

2.1 Defining taste

Sensory perception is the way in which we as human beings experience the world around us. The senses are the tools we use in order to detect our surroundings. The experience of sensing can either be regarded holistically, considering the body and mind as one complete unit of perception or more commonly to divide sensory input into distinct domains, i.e senses (for a discussion see Merleau-Ponty 2012: 214–252). The standard way to do this is through the division between vision, hearing, touch, taste and smell. This classical division can be traced back to Aristotle and is the most influential model for dividing human perception in the Western world (Aristotle [350 BCE] 1986: 110–128). However, despite its intuitive validity, this model may not accurately describe the anatomy of taste. The division of the five senses has been proposed to be a "folk model" that is nothing but a "useful fiction" (Winter 2019: 11–15). One indication of this is how the sensation of pain is perceptually and neurologically separated from other tactile sensations (Speed & Majid, 2020). For present purposes, the deep entanglement between taste and smell is more immediately relevant. Already Aristotle was aware of this close connection and wrote in his classic *De Anima* that: ”the species of flavor are analogous to the species of smell" (Aristotle [350 BCE] 1986: 122). Most people have experienced reduced sense of taste during the loss of smell, for instance when one has a cold. The explanation for this is that "taste strongly involves retronasal olfaction—smelling via the oral cavity during eating and drinking" (Speed & Majid, 2020: 373). The actual taste is picked up by the taste buds which are spread across the tongue and soft palate. They are made up of clusters of skin-like cells connected to neurotransmitters, passing on the information to the brain (see Figure 1). Various kinds of protein receptors are responsible for distinguishing mainly five basic taste qualities: sweet, salty, sour, bitter and umami. A persistent myth says that different areas of the tongue are responsible for certain kinds of taste, but any of the basic tastes can be perceived anywhere on the tongue (Lawless & Heymann 2010: 27–34). The more specific characteristics of flavor, also called *aroma,* are actually not perceived by the taste buds, but through retronasal smelling: "The lemon character of a lemon, for example, is derived not from lemon taste (which is only sour, sweet, and bitter) but from the terpene aroma compounds that arise in the mouth and pass up into the nasal cavity from the rear direction (retronasally)" (Lawless & Heymann 2010: 36).

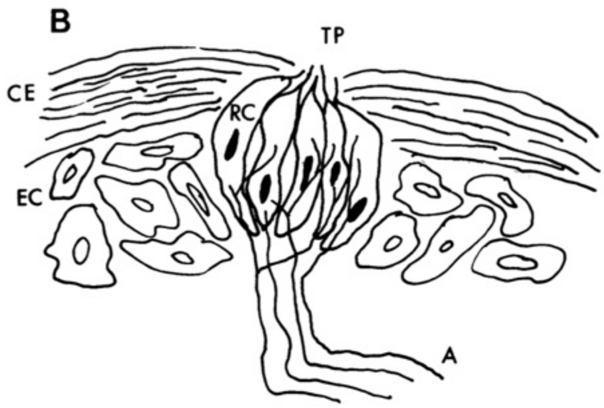

Figure 1. Cross-sectional drawing of a taste bud (Lawless & Heymann 2010: 28)

Revisiting the five sense model, the close connection between smell and taste would argue for merging these senses into one overt "chemical sense", leading to the unpleasant conclusion that the five sense model is both too narrow and too broad[1]. The current study will for sake of simplicity follow the five sense model. Since it is the most common way to categorize sensory input in our society, it is also heavily integrated in the language. While language reflects human culture more than human anatomy, challenging this distinction would not be a productive starting point for a linguistic study. As Winter (2019: 136) states, "Sometimes it is best to work within a theory to prove it wrong."

2.1.1 Taste vs flavor

When describing what we perceive as taste we most often refer to the chemosensory merging of taste and aroma and the taste and smell vocabularies in English show a big overlap (Winter 2019: 164–165). English handles this by separating the concept of *flavor* — referring to both taste and smell — from *taste*, which instead refers to the isolated input of the taste receptors on the tongue. Not everyone is aware of this distinction and the terms are often used interchangeably in everyday language. Despite this, the current study applies the more technical use of these terms. This means that *flavor* includes taste and aroma, while *taste* addresses only taste. However, since flavor does

[1] Speed & Majid (2020: 364) puts it like this: "At one extreme, we could enumerate sensory modalities by stimulus type, and thus distinguish three: light (vision), mechanical (touch, hearing), and chemical (smell, taste) senses. At the other end, we could base our classification on receptor types leading to more than 30 distinct "senses"."

not form a verb, the English verb 'to taste' will continue to apply to both meanings, i.e the act of acknowledging both taste and aroma.

Since the current study was conducted in Swedish but written in English, it is worth noticing that the Swedish language lacks such lexical distinctions. The word *smak* is used to describe both taste and aroma as well as the specific experience of taste, making the English language less ambiguous in this context.

2.1.2 Texture and gustatory experience

Another domain that is often confused with taste is the tactile sense. Tactile impressions in relation to gustatory experiences are mainly associated with what is known as *texture,* which describes the structure and viscosity of foods rather than the chemical impressions perceived as tastes and aromas. Some examples would be descriptions such as 'crispy', 'creamy' and 'sticky'. Texture is a complicated matter in sensory evaluation and is really perceived by touch, sight and hearing simultaneously (Lawless & Heymann 2010: 259–276). The current study will for the sake of simplicity refer to texture as *tactile impressions*. The separation between texture and flavor makes up an important distinction in the current study further addressed in Section 3.4.1.

A gustatory experience is also heavily impacted by other sensory impressions than smell and touch, such as vision, e.g the color of a cup has been shown to influence how we perceive the taste of coffee (Carvalho & Spence 2019), and audition, e.g music and soundscapes are proven to influence gustatory perception in a number of ways (Guedes et al. 2023)[2]. When referring to the multimodal experience, involving all five senses surrounding eating and drinking as a whole, the current study uses the term *gustatory experience* and the adjective *gustatory* refers to the multi-modal experience of eating and drinking. For example, a *gustatory description* consists of all possible sensory impacts connected to a certain stimuli, while a description of taste, flavor or texture is limited to the definitions provided above. In a terrain like this, marked by many ambiguities, it is of vital importance to work with clearly defined concepts. The lexical definitions submitted so far are summarized in Table 1, with the lexical units listed on top in the X-axis and the different semantic attributes listed in the Y-axis.

[2]In one study, participants were set to listen to their own chewing noise when eating potato chips: "the results suggested that chips were perceived as fresher and crisper when listening to the sound with amplified frequency and/or volume compared to when the sound was unaltered." (Guedes et al. 2023: 2)

	Taste	*Flavor*	*Texture*	*Gustatory experience*
Basic tastes	yes	yes	no	yes
Aromas	no	yes	no	yes
Tactile input	no	no	yes	yes
Multimodal input from all senses	no	no	no	yes

Table 1. Lexical definitions of taste, flavor, texture and gustatory experience.

2.2 The Grounded Cognition Model

The Grounded Cognition Model (GCM) proposes that basic cognitive abilities are heavily entangled with the sensory motor cortex in the human brain. According to GCM, corresponding parts of the sensory motor cortex are activated when perceiving and producing language and during non-linguistic mental simulations, for example when looking at pictures of certain objects or events (Barsalou 2008, Ganis 2013, Avery, Carrington & Martin 2023, Spence 2024). Research using neuroimaging methods also show that when exposed to spoken linguistic descriptions of motion events, the same neocortical regions are activated as those associated with performing the motion (Pulvermüller 2005). This can be seen as indications that the foundations of language and thought are closely related to bodily perception: "We think about the world by means of the same mechanisms that we use to experience it" (Dove 2022: 1). In this section, I present GCM mainly from a linguistic and semantic perspective with a specific emphasis on the gustatory domain.

2.2.1 Modal systems vs amodal symbols

GCM is often contrasted with so-called "classical" semantic theories, particularly regarding whether the core of semantic meaning is rooted in modal systems or amodal symbols (Barsalou, 2008). The classical semantic theories consider word meaning to be represented by self-sufficient amodal symbols in the brain. One example is the *language of thought* (or *mentalese),* proposing language to be underlined by a semantic representational system of non-linguistic concepts (Fodor 1975). These concepts can be regarded as independent from both the mental lexicon as well as from other cognitive functions. Semantic meaning is regarded as a separate system of information tied to certain word forms in a more or less arbitrary and symbolic fashion.

In contrast to classical theories, GCM instead ties word meaning directly to the sensory motor cortex. This means that language and mental simulations automatically activates the same kind of brain activity as when one lives through the experience and this connection is the core of semantic meaning. Explaining and comprehending certain actions or experiences are thus a neurological reenactment of the corresponding events. GCM thus dismisses semantic meaning stored separately as amodal symbols. Instead, meaning should be understood as actual interaction with the body and perceptual systems in the modal regions concerned in each case.

2.2.2 GCM and the gustatory domain

GCM proposes a direct bridge between sensory experience, cognition and language. However, this is in most cases exemplified through empirical studies involving the visual and auditory senses, e.g by using objects, sounds, pictures or videos as stimuli and looking at behavioral and neurological reactions in relation to their linguistic counterpart (Barsalou 2008). When it comes to the senses of touch, taste and smell, there is less empirical support (Speed & Majid 2020). In the taste domain specifically, it immediately raises the issue of separating the specific experience of taste from the multisensory gustatory experience, involving particularly retronasal olfaction, temperature- and pain receptors in the mouth (for example when consuming hot or spicy food) as well as texture. This obstacle of defining what taste actually is and how it can be delimited from other senses might explain the scarcity of studies targeting the gustatory domain. There is however quite convincing studies showing taste and smell to be grounded in mental simulation (Spence 2024). For example, an fMRI study found increased activity in the bilateral dorsal mid-insula (the primary region in the brain responsive to gustatory experience) when participants were presented with images of food (Avery, Carrington & Martin 2023). This indicates that there is support for GCM in the gustatory domain and what is needed is to study this empirically in more detail.

2.3 Cross-linguistic differences in sensory language

There is considerable cross-linguistic variation to be found in sensory language. One of the early and most influential studies was conducted by Brown & Lenneberg (1954) on color recognition in English and the native American language Zuni. They showed that English speakers used a broader variation of basic color terms than the Zuni speakers and they were faster and more precise when confronted with a simple color naming task. Brown and Lenneberg came up with a way to measure proficiency in putting sensory impressions into words, which they called *codability.* Further, they argued that since English speakers had more abstract color terms and were faster at naming colors, the corresponding colors were more *codable* in English than in Zuni.

Extending from Brown & Lenneberg, codability has later been used to look at all kinds of sensory input. One notable example is Majid et al. (2018) that found major cross-linguistic differences in the hierarchy of the senses. This study examined how well different language communities performed in simple naming tasks in all of the five senses. Figure 2 shows a visualization of their findings where the different symbols on top of the diagram from left to right represent: smell, taste, touch, hearing and sight (the last divided into shape and color). The examined languages are listed on the Y-axis. Symbols appearing further to the right in the diagram are more codable in the respective language. A common belief in the Western world (something that also can be traced to

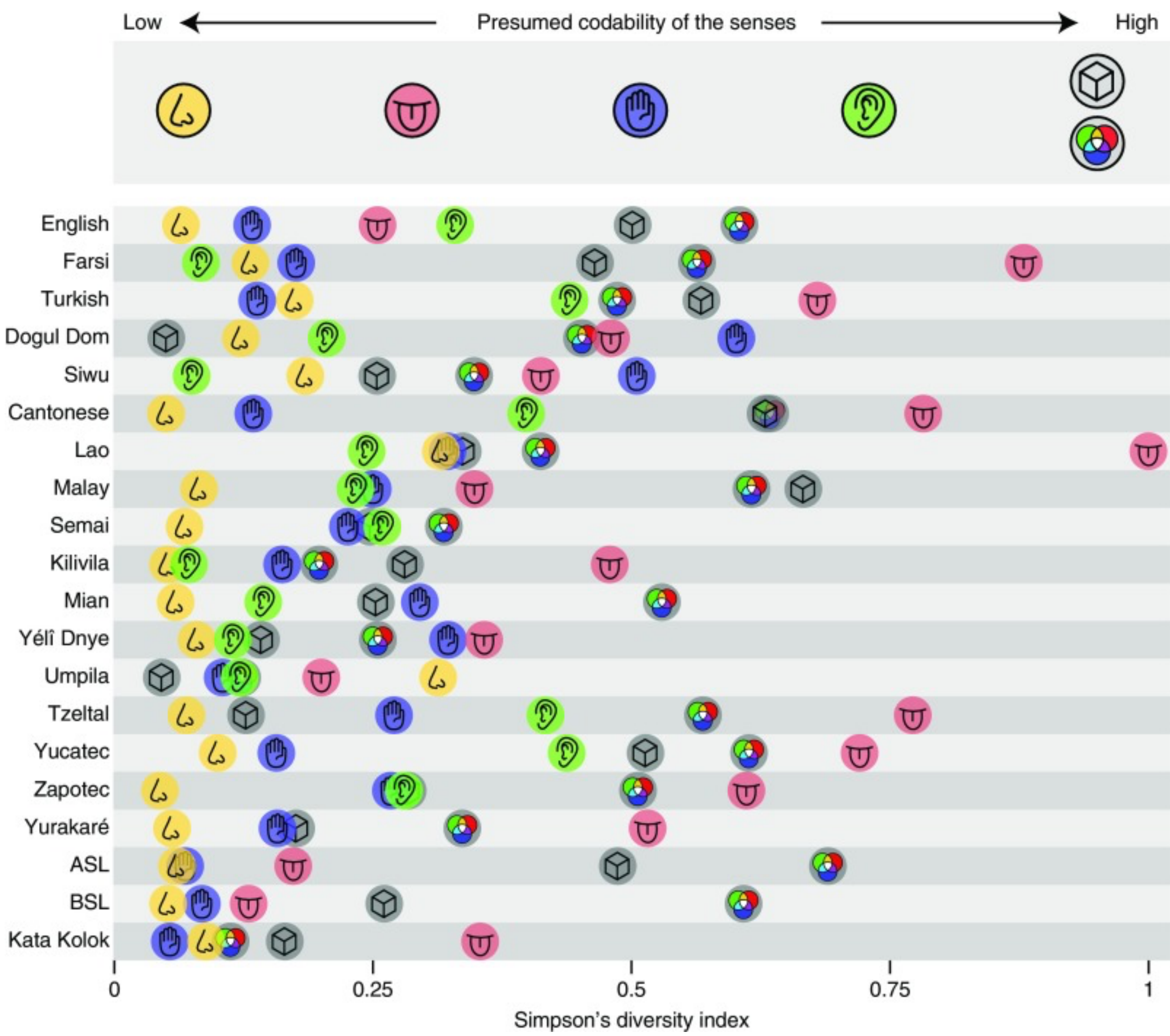

Figure 2. Hierarchy of the senses in 20 languages (from Majid et al. 2018)

Aristotle) is that sight and hearing are superior to touch, taste and smell which is apparent in that the latter three are often collectively referred to as "the lower senses". Although this Aristotelian hierarchy is reflected in the English language, other languages show considerable variation as clearly visualized in Figure 2. Particularly interesting for the current study is the major differences found in the taste domain. Taste seems to be showing one of the greatest cross-linguistic variation of all senses (Majid et al. 2018).

2.4 The current study

A key issue that follows from the discussion above is whether the typological differences found in sensory language are primarily shaped by linguistic structures or if domain expertise also plays a significant role. Could it be that the ability to express oneself about certain sensory experiences is in fact strongly influenced by other factors than language affiliation, such as individual competence and experience? Basic insights from the field of sensory evaluation implies so. When eliciting data to test food products, it is standard procedure to use a trained sensory panel, rather than average consumers. The reason being that "consumers not only act in a non-analytic frame of mind but also often have very fuzzy concepts about specific attributes, confusing sour and bitter tastes, for example." (Lawless & Heymann 2010: 9).

If trained experts are in fact "better" at encoding gustatory experiences, the same kind of difference might be valid in other sensory domains as well. Another assumption would be that such differences not only applies to clear-cut cases, such as the ones between trained experts and laypeople in a certain domain, but rather fluctuates within a language community in a seamless and nuanced way. By examining codability in gustatory descriptions in laypeople and trained experts, this thesis aims to address this issue. The main point being that measuring cross-linguistic differences might be misleading if intralingual variations are ignored.

From the perspective of sensory evaluation, gaining a deeper understanding of how laypeople and experts differ in encoding sensory experiences could be highly valuable. A central question in this field focuses on achieving effective communication between the food industry and their consumers. It is reasonable to assume that a better understanding of how and why laypeople and experts would differ in their descriptions of gustatory input has the potential to make significant contributions to this area.

Previous linguistic studies on differences of gustatory codability in laypeople and trained experts are scarce, but worth mentioning is Croijmans & Majid (2016). They examined descriptions of flavor in coffee and wine experts compared to laypeople. In this study, performed in Dutch, only a marginal difference in codability between the three groups: wine experts, coffee experts and laypeople was found. With some methodological alterations the current study conducted a similar experiment. The main differences were:

1. The language of focus, i.e Swedish instead of Dutch. As clearly shown by previous research, large cross-linguistic differences in codability can be expected in all sensory domains. It is therefore of vital importance to try out similar approaches in different languages to find out how sensory language functions both within and between languages.
2. The use of trained experts with a more general expertise in sensory evaluation. With this approach, I seek to provide a wider understanding of gustatory language rather than focusing on a specific subset of products that may rely on a highly specialized lexical framework. Notably, wine terminology is known for its particularly specialized vocabulary (Herdenstam et al., 2009).

To establish a starting point for discussing GCM, participants were presented with image stimuli and asked to describe the imagined flavor. The aim was to explore potential differences between descriptions based on mental simulation and those derived from actual gustatory experiences. The interplay between mental simulation, sensory experience, and language is a central focus within GCM. Thus, this approach was meant to provide a relevant base for exploring the theory further. However, this experiment should be regarded as a highly exploratory component of the study, primarily initiated to form a discussion about GCM rather than to offer definitive empirical conclusions.

3. Data collection and analysis

This section presents a detailed description of the data collection and analysis conducted in the current study. All material referred to can be found in Appendix.

3.1 Participants

The experiment elicited taste descriptions from trained experts and laypeople. The following two groups were consulted:

1. 5 members of a sensory panel working specifically with gustatory evaluation in food products. All was in the last year of a 3-year training in gastronomy at Kristianstad Högskola except for one who already finished the program. This group is referred to as *the expert group* or simply *the experts*.
2. 5 novice participants, balanced for age and gender of the expert group. This group is referred to as *the laypeople group* or simply *the laypeople.*

Since all experts turned out to be women except for one non-binary person the laypeople group was matched to consist of only female participants. This resulted in 9 female and one non-binary participant. All participants admitted to having no food allergies related to the stimuli and no other medical conditions affecting their ability to sense or experience flavor. The mean age in the expert group was 34.8 years (SD = 6.9) and 31 years (SD = 9.8) in the laypeople group. On a scale from one to six in level of interest in gastronomy/foods/drinks, the experts all stated the maximum value (6) while the laypeople had a mean of 3.2 (SD = 1.1). All participants had Swedish as first language. Four of the experts stated English as their second language, one Italian and one Danish. All participants in the laypeople group stated English as a second language, three French and one spoke Polish, Spanish and Danish. In the laypeople group, one participant had been working briefly as a chef and bartender, the same participant had a special interest in cocktails and another participant had attended a wine-testing course. Apart from the training stated above, all experts stated some sort of special culinary interest (e.g special coffee, fermentation and nutrition). One was also a trained sommelier and had been working in Systembolaget (the Swedish alcohol monopoly).

3.2 Material

The stimuli consisted of nine samples divided into three conditions. Condition 1 consisted of fruit and vegetable drinks. Condition 2 consisted of solid foods. Condition 3 consisted of images of various food products. The products are specified in Table 2, images used can be found in Appendix 4.

Condition 1: Drink	Condition 2: Solid Food	Condition 3: Image
Sea buckthorn	Dark chocolate, 85 % cacao	A sliced lemon
Cranberry	Parmesan cheese, aged 30 months	A half peeled banana
Tomato	Dried apricot	A cup of coffee

Table 2. Overview of stimuli conditions.

The drinks were served in 20 ml brown glass bottles, the color of the drinks were hidden and the participants were not able to visually identify the content. The solid foods were cut into flat cubes and individually presented in small plastic containers. Unlike the drinks, the visual appearance of the solid food was not concealed. All food samples were stored in a refrigerator, transported in a coolbag and served at a temperature between 4–8 degrees. The images were printed in high resolution on A4 paper sheets and presented by the conductor on a distance of approximately 1 meter from the participants.

3.3 Procedure

All sessions took place in a quiet room with a minimum amount of distracting sensory elements (e.g strongly colored wallpaper or distinctive smells). Each participant was placed in a chair without any armrests in front of a white wall facing a camera on a tripod. Before starting the actual experiment, the participants signed a consent form where they agreed that their answers would be audio- and video recorded (see Appendix 1). Thereafter, they were presented with a written description of the experiment in Swedish (see Appendix 2). This description thoroughly explained the process of the experiment. The procedure was presented in six steps aimed directly to the reader:

1. The taste samples will be given to you by the conductor. The images will be shown at a distance.
2. Take the whole sample at once and then return the container to the conductor. You are allowed to look at the images as long as you like.
3. When you feel ready to start your description, turn to the camera.

4. Describe the taste as detailed as possible facing the camera, start your description with the phrase ‘it tastes…’.
5. Your answers (audio and video) will at a later point be presented to another group of participants. This group will try to identify and choose the right stimuli among a set of ten samples with the help of your descriptions. This group will receive the samples in another order, it is therefore important that you don't make any references between the samples.[3]
6. Before starting the recording we will do a test round so that you become familiar with the procedure.

In addition to this information the participants were also requested to:

- To the extent possible **not** include any other sensory impressions than flavor in their descriptions.
- When describing the images, to avoid phrasings like ‘I think/imagine that it tastes…’ but instead treat them like the other samples, i.e with the phrasing ‘it tastes…’.
- Not to include the name of the particular product in their description (e.g when shown an image of an orange, not to simply say ‘it tastes orange’
- To treat every sample uniquely, not referring to previous samples in their descriptions.
- To drink water between each sample.

The samples were given in a pseudo-randomized order following a constraint related to the different conditions. The order was: Group 1 (drinks) — Group 2 (solid foods) — Group 3 (images). This order was repeated three times for each participant. After the session was finished, the participants were asked to answer a short questionnaire, stating their age and gender, listing what languages they spoke, level of interest in food and gastronomy and to specify their potential background, training or work experience in culinary arts (see Appendix 3).

3.4 Analysis

The gathered data was firstly transcribed word by word into standard Swedish orthography in Pages. Filled and silent pauses as well as interjections were not included. Gustatory descriptions

[3] Point 5 was merely a way to motivate the participants to put more effort into the task and also to highlight the point to not make relative descriptions. In reality, no second group of participants existed.

were annotated according to their meaning, these are called *target lemmas*. For example, in (1) describing dried apricots, two target lemmas were annotated: SWEET and OLD.

(1) *Det smakar sött, men, men kan beskriva det nästan lite gammalt.*
‘It tastes sweet, but, but can be described as almost a bit old.’

Occurrences of the same target lemma were only counted once per stimuli. Basic tastes were sometimes repeated, but in a different word form. A typical case would be the adjective *söt* ‘sweet’ and noun *sötma* ‘sweetness’, in which case they were annotated as two different target lemmas. The target lemmas were divided according to the semantic categories listed and explained in Section 3.4.1.

Negative expressions and gradients were sometimes used to produce descriptions by means of contrast. With respect to the former, they were consistently annotated as individual target lemmas in the same categories as their positive counterparts, only with an added NEG/ notated before. (2) provides an example from a description of dried apricots in which three target lemmas were annotated: NEG/SOUR, NEG/BITTER and SWEET:

(2) *Men, men den är ju inte sur alls. Inte besk, väldigt söt.*
‘But, but it's not sour at all. Not bitter, very sweet.’

Gradient words and phrases were not included among target lemmas. For example, the phrasing ‘very sweet’ in (2) was annotated as SWEET.

The elicited data was annotated in Numbers (the MacOS spreadsheet application) and the target lemmas were placed into their respective categories. A total word count was elicited from each description in Pages. Target response time was measured using ELAN (ELAN 2024). All other calculations were done in Numbers. Statistical tests were performed using the calculators on www.socscistatistics.com and presented according to their standards. The diagrams were produced with the help of ChatGPT.

Since the use of generative AI in academia could be controversial, a more detailed description might be in place regarding the use of ChatGPT. After retrieving all the numbers in one of the calculations they were used to formulate clear and simple instructions for ChatGPT to produce visualizations of the values. For example, the target response time was measured and a mean average and standard deviation was retrieved for each group in Numbers. The following instruction was then given to ChatGPT: “Produce a simple bar chart with two bars for each of the groups Experts and Laypeople showing values for mean target response time in ms. The values are: Experts *M* = 19012 *SD* = 10897 and Laypeople *M* = 15415 *SD* = 7645.” This was enough to get the basis for a bar chart layout. The layout in the diagrams could then be corrected and manipulated using instructions formulated in English prose, which is very convenient for someone who is not very well oriented in coding and graphic design. ChatGPT mainly uses the Python library Matplotlib for creating diagrams.

3.4.1 Measuring codability

As already mentioned, Brown & Lenneberg (1954) introduced codability by looking at cross-linguistic differences in color naming and it was further expanded by Majid et al. (2018), Croijmans & Majid (2016) and Majid & Burenhult (2014) to cover all five senses. Basically, codability is a way of measuring how well experiences of certain sensory input are transcribed into language. In a study on olfactory descriptions in the Austroasiatic language Jahai, Majid & Burenhult (2014) offers the following definition: “we operationalized codability in three ways: (1) speaker agreement in descriptions, (2) length of utterance, and (3) type of response offered (abstract, source-based, or evaluative).”

1) Means that higher codability would correspond with more people agreeing on a certain term related to a certain stimuli.
2) Means that shorter answers (in words) would be considered more codable than longer ones.
3) Refers to the semantic categories used in the descriptions. The main point being that a higher use of the Abstract category would indicate higher codability.

When analyzing the data, the current study proceeded from this understanding of codability. The original codability measure offered by Brown & Lenneberg (1954) also looked at reaction time. Therefore, a target response time measure was adopted to the analysis, i.e the time measured from intake of a stimulus to the utterance of the first target lemma. A faster response time would indicate higher codability.

3.4.1.1 Semantic categories

To provide a better understanding of the semantic categories and how they were applied in the current study, each category is explained and discussed below. Particularly difficult cases are addressed with relevant examples.

Abstract: Words or phrases with a specific inherent meaning in relation to flavor. This is the strategy mainly relevant to the codability measure and inherents the basic tastes: sweet, salty, sour, bitter and umami. Generally consisting of a single adjective, this category also includes descriptions referring to intensity, e.g *mild* 'mild' and *stark* 'strong', and other descriptions defining the character of flavor in a more abstract manner, e.g *rutten* 'rotten' and *exotisk* 'exotic'. There were many cases where the Abstract category was hard to differentiate from other categories. Such cases will be discussed below.

Source: Words or phrases related to a specific or categorical source. This category was easily detected when expressed through a single noun phrase, for example one participant described sea buckthorn with the following description:

(3) *nån typ av söt frukt eller bär*
'some kind of sweet fruit or berry'

In (3), two target lemmas: SWEET FRUIT and BERRY were annotated as belonging to the Source category. It got more complicated when the same kind of categorical sources were used as an adjective:

(4) *nån typ av fruktig smak*
'some kind of fruity taste'

In (4), one target lemma: FRUITY was annotated. The key question was whether FRUITY should belong to the Source or Abstract category. It could be interpreted as meaning 'tasting like a fruit', in which case it would be a Source lemma. However, FRUITY can also convey a meaning that does not directly reference fruit as a category. Instead, it may describe a characteristic sweetness and freshness, detached from the fruit category, thereby aligning better with the Abstract category. This detachement from the categorical source is even more obvious in adjectives like *nötig* 'nutty' or *blommig* 'flowery', which were frequently used by some participants. Few would argue that 'nutty' and 'flowery' would mean 'tasting like a nut' or 'tasting like a flower'. They rather describe abstract characteristics, clearly detached from their categorical sources. Because of this, it was decided to overtly use word class as the crucial element, meaning that noun phrases like 'sweet fruit' most often were placed in Source and adjectives like 'fruity' in Abstract. Exceptions were made when basic tastes were expressed through a noun phrase, e.g 'it has a sweetness to it', in which case SWEETNESS would still be regarded as an Abstract target lemma.

Evaluative: Words or phrases with a hedonistic meaning, rather describing the attitude towards the flavor than the flavor itself. This category was without question the least frequent and seldom entailed any difficulties. Typical examples would be *god* 'good' or *inte god* 'not good'.

3.4.1.2 Multimodal input

For this section, a short recap from Section 2.1 is needed: The definition of taste is — as previously discussed — surrounded by two main issues:

1. The physical anatomy of the perceptual system does not correspond one to one with the cultural classification of the senses.
2. The gustatory domain is especially hard to define while taste and smell are heavily entangled and also affected by other sensory input.

These issues became increasingly important when designing the task for the study. It was crucial for the participants to know whether they were supposed to describe the multimodal gustatory experience or if they should rather isolate the sensation of flavor or even taste. As previously discussed, the lexical division of taste/flavor does not exist in Swedish, which further emphasized the need for clear instructions. Since the definition of taste and flavor is fraught with many difficulties, an additional question arose concerning this: Do experts and laypeople differ in their ability to differentiate sensory input?

As a way to incorporate this question into the experiment, the participants were asked to only evaluate flavor and exclude any other sensory input in their descriptions. The rationale for this decision was to examine how good the experts and laypeople were at making this distinction. Since the division between taste and aroma is not very well established the difference between taste and retronasal smell was not included in the task. There is however a defined way to talk about texture and other tactile experiences related to eating and drinking. These kind of descriptions were divided into a separate semantic category named Tactile. In addition to this, yet another category was constructed named Meta, gathering all kinds of target lemmas referring neither to flavor nor the tactile sense explicitly. This gave a total amount of five categories: Abstract, Source, Evaluative, Tactile and Meta. The two latter are further described below:

Tactile: Words or phrases related to the tactile domain. Mostly words referring to texture, e.g *tjock* ‘thick’ or *krämig* ‘creamy’, but also referring to temperature, e.g *värmande* ‘warming’.

Meta: Descriptions referring neither to flavor nor touch explicitly, but to other associative or ambient impressions. This category involved some of the most complicated cases and conflicted at some point with most of the other categories. Consider the following example describing coffee flavor:

(5) *Men det smakar ju som, det är lite, det är en vanlig smak. Det har man testat men det kan ju variera lite mellan olika sorter men det här är en så väldigt traditionell smak.*
‘But it tastes like, it’s kind of, it’s a common flavor. You’ve tried it before, but it can vary a bit between different types, but it is a very traditional flavor.’

In (5), two target lemmas were annotated COMMON and TRADITIONAL. Even though they both describe characteristics referring to the gustatory experience they were not judged to be Abstract descriptions of flavor. They rather explain separate cultural aspects related to the flavor. Therefore they were placed in the Meta category. Another example, this time a description of sea buckthorn:

(6) *det känns som att det kan sitta på ett träd*
‘It feels like it could grow on a tree.’

At first sight, the target lemma FROM A TREE can be seen as a Source description: it does attempt to describe the source of the flavor. However, it is not the direct source it alludes to, but rather the source of the source, which would make it more of a Meta description. Yet another example, this time about dark chocolate:

(7) *smaken liksom fastnar i gommen, man sväljer och sväljer men ja, det sitter kvar en stund*
‘The taste sort of sticks to the palate, you swallow and swallow, but yeah, it stays for a while.’

Two target lemmas were annotated from (7); STICKS TO PALATE and PERSISTENT, both of which might be regarded as Tactile descriptions. However, they do not refer to texture explicitly, but rather placement and time aspects related to the experience of texture. Therefore, these lemmas too were assessed as Meta.

3.4.1.3 Precision

The current study introduced an additional parameter to the codability measure, focusing on the precision of language use. This adjustment was made because previous research on codability has often relied on very simple naming tasks, for example by using basic color terms or basic tastes as stimuli. In contrast, this study elicited detailed descriptions of more complex stimuli, where simply counting words would likely be an overly simplistic approach. This is best illustrated using an example; consider the following two outtakes describing parmesan cheese, where (8a) was produced by a layperson and (8b) by an expert:

(8a) *Det känns som att den, det smakar lite strävt i munnen men en god, sträv men ändå lite åt det krämiga hållet, en väldigt liten touch av krämighet men mest strävt. Det smular snarare i munnen och sen så lite mer krämigt.*
‘It feels like it, it tastes a bit rough in the mouth but tasty, but still leaning a bit in the creamy direction, a very small touch of creaminess but mostly rough. It rather crumbs in the mouth and then a little more creaminess.’

(8b) *Det smakar mycket umami och salt. Även lite mjölk, lite surt. Det smakar vasslepulver. Nästan lite rå äggula.*
‘It tastes very umami and salty. Also a bit milky, slightly sour. It tastes like whey powder. Almost a bit like raw egg yolk.’

(8a) contains a total amount of five target lemmas, four Tactile: ROUGH, CREAMY, CREAMINESS, CRUMBY and one Evaluative: TASTY. (8b) contains a total amount of six target lemmas, three Abstract: UMAMI, SALTY, SOUR and three Source: MILKY, WHEY POWDER, RAW EGG YOLK. Since four of the lemmas in (8a) belong to the Tactile category, referring to texture, this participant had a sum of only one flavor description (TASTY), while (8b) had a sum of six (UMAMI, SALTY, SOUR, MILKY, WHEY POWDER, RAW EGG YOLK). Comparing the amount of flavor descriptions in (8a) and (8b) to the word count, the layperson used 42 words for one flavor description, while the expert in (8b) used 18 words for six flavor descriptions. The ratio between the word count and the amount of flavor descriptions was used as a way to measure how *precise* the language use was in relation to the task. A more precise language use would be regarded as more codable.

3.4.1.4 Agreement

Due to the broad variation of descriptions, it was not very practical to measure agreement on all target lemmas. In the categories Abstract, Source and Evaluative alone there was a total amount of 205 unique target lemmas with some of them used only once. Moreover, while one participant only used two individual target lemmas to describe parmesan cheese, another participant counted up to eleven unique descriptors. However, something that all participants conveyed to at least once in each description was the use of basic taste words. This made basic taste words into a suitable category for the comparison of agreement between the two groups. Furthermore, basic taste words have a central role in the semantic field of gustatory descriptions and the variation could be restricted to five individual target lemmas: SWEET, SALTY, SOUR, BITTER, UMAMI. Each basic taste was counted only once for each description, leading to a maximum value of five for each description. Negative descriptions were not included and a nominal phrasing such as the previously discussed 'sweetness', were added to the SWEET-category in this measure. Accordingly, each combination of product and basic taste word was given a value from one to five within each group. If the value was five, all of the participants in the group agreed upon this combination. For example, in both groups, all participants at some point stated SWEET when presented with an image of a banana, which gave the value *5* for the combination banana—SWEET for both groups. One participant in the laypeople group stated BITTER for banana which gave the value *1* for the combination BITTER-banana in the laypeople group. Only active agreement was measured and since none of the experts conveyed to this particular combination, this value was invisible for the expert group and therefore not part of the calculation. This was done for all unique combinations of products and basic taste words within each group.

3.4.1.5 Target response time

Target response time was measured from the moment the stimuli was presented to the moment the first target lemma was uttered. Due to the different conditions of the stimuli (Drink, Solid Food and Image) this had to be measured a bit differently: Drink was measured from the moment the participant had finished drinking and lifted the bottle from the lips, Solid Food was measured from the moment the stimuli entered the mouth and Image was measured from the moment the image was presented to the participant. A faster target response time would indicate a higher codability.

4. Results

The following Section presents the analysis of the elicited data, addressing the specific questions listed in Section 1.1. The questions — 1 to 5 — are repeated at the beginning of each Section followed by a relevant analysis. Data used for the calculations can be found in appendix 5. In the current study, the null hypothesis states that there is no statistically significant difference between experts and laypeople in the measured variable. All significance levels are compared to the standard threshold of .05, which serves as the criterion for rejecting the null hypothesis. In any case, the error bars in the figures represent standard deviation.

4.1 Semantic categories

Do the different groups show a significant difference in their use of semantic categories?

The total amount of target lemmas were similar between the groups (laypeople = 265, experts = 269) making it easy to compare. A Chi-squared test was performed including all five semantic categories, showing a significant difference between the experts and the laypeople ($X^2(4, N = 534) = 72.46$, $p < .001$). As shown in Figure 3, both groups tended to use Abstract descriptions mostly. When grouping the remaining four categories into one group representing the condition *non*

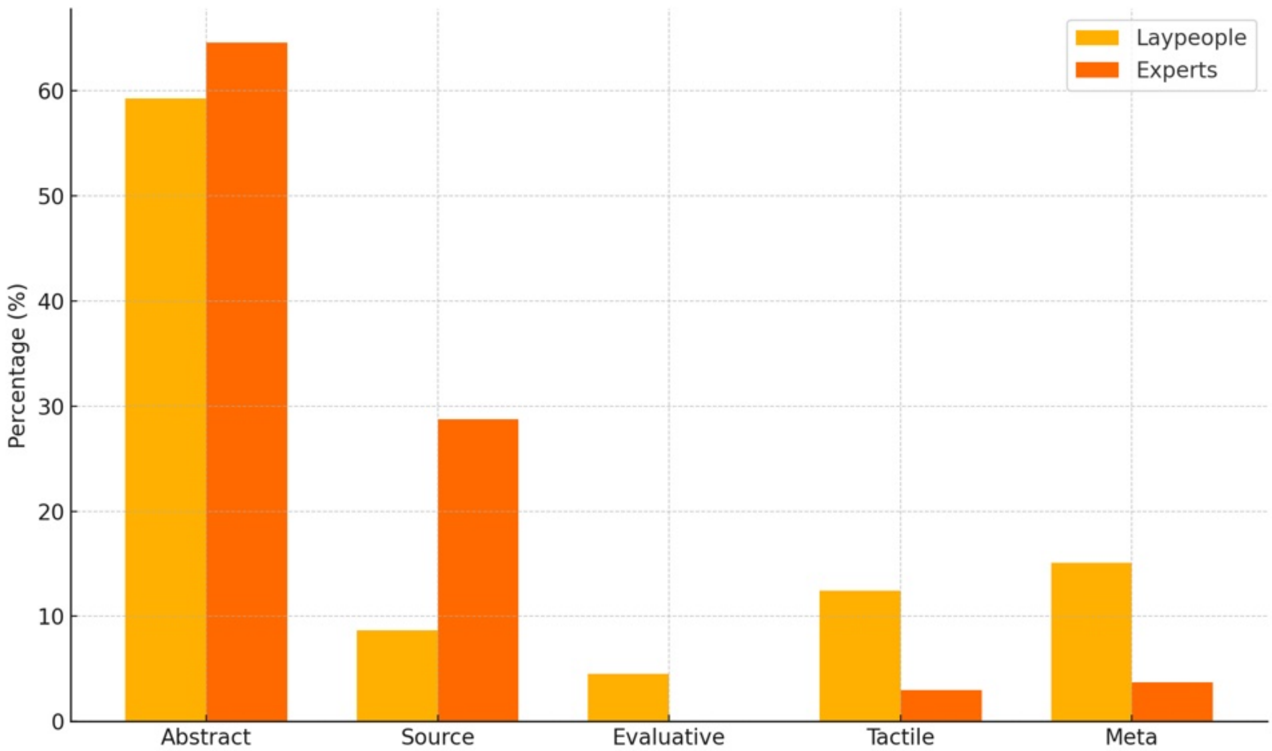

Figure 3. Total use of target lemmas divided by their specific semantic categories

abstract and comparing these to the Abstract category, no significant difference was found between the groups ($X^2(1, N = 534) = 1.45, p = .228$). The Abstract category is mainly considered to coincide with higher codability, thus, no support for higher codability could be found in this measure. The difference rather concerned the use of the other categories. While the expert group used Source descriptions to a larger extent, the laypeople were more spread across the board. Importantly, they tended to use considerably more Tactile and Meta descriptions than the experts. When the categories Abstract, Source, and Evaluative were grouped into a single category representing the condition *flavor specific*, and Tactile and Meta were grouped into another category representing the condition *non-flavor specific*, a significant difference between the groups was found between these two overarching categories ($X^2(1, N = 534) = 41.07, p < .001$). This means that the expert group were more likely to use flavor descriptions than the laypeople group, indicating that the laypeople seemed to have a harder time following the task description and differentiating sensory input. The results are visualized in Figure 4.

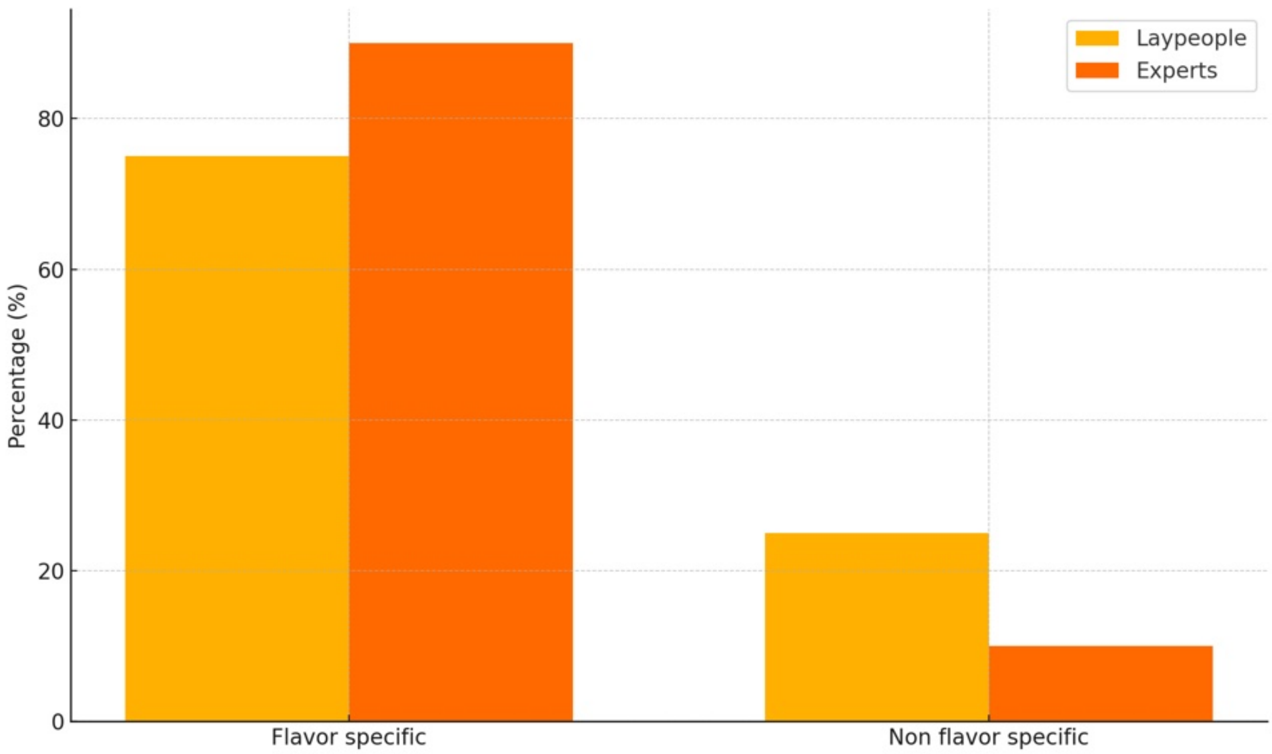

Figure 4. Total use of target lemmas divided by the overt categories 'flavor specific' and 'non flavor specific'

4.2 Description length

Do the different groups show a significant difference in description length?

There was a significant difference in the amount of words used per stimuli between the two groups ($t(88)$ = 4.68, $p < .001$). The laypeople (M = 51.2 SD = 37.7) used more words on average per stimuli than the experts (M = 23.9, SD = 11.1). Since shorter descriptions are associated with higher codability, this lends support for the experts' description exhibiting higher codability.

4.3 Precision

Do the different groups show a significant difference in precision?

In total, the laypeople used more than twice the amount of word tokens as the experts (2306 vs 1077). In contrast, the experts produced more flavor descriptions (249 vs 194), i.e target lemmas belonging to either of the three semantic categories Abstract, Source or Evaluative. The difference in precision between the two groups was found to be significant (t(88) = 5.94 , $p <$ .001), with the laypeople (M = 11.08 SD = 7.19) showing a higher amount of words per flavor description than the experts (M = 5.51 SD = 1.94). Thus, the experts used their words more

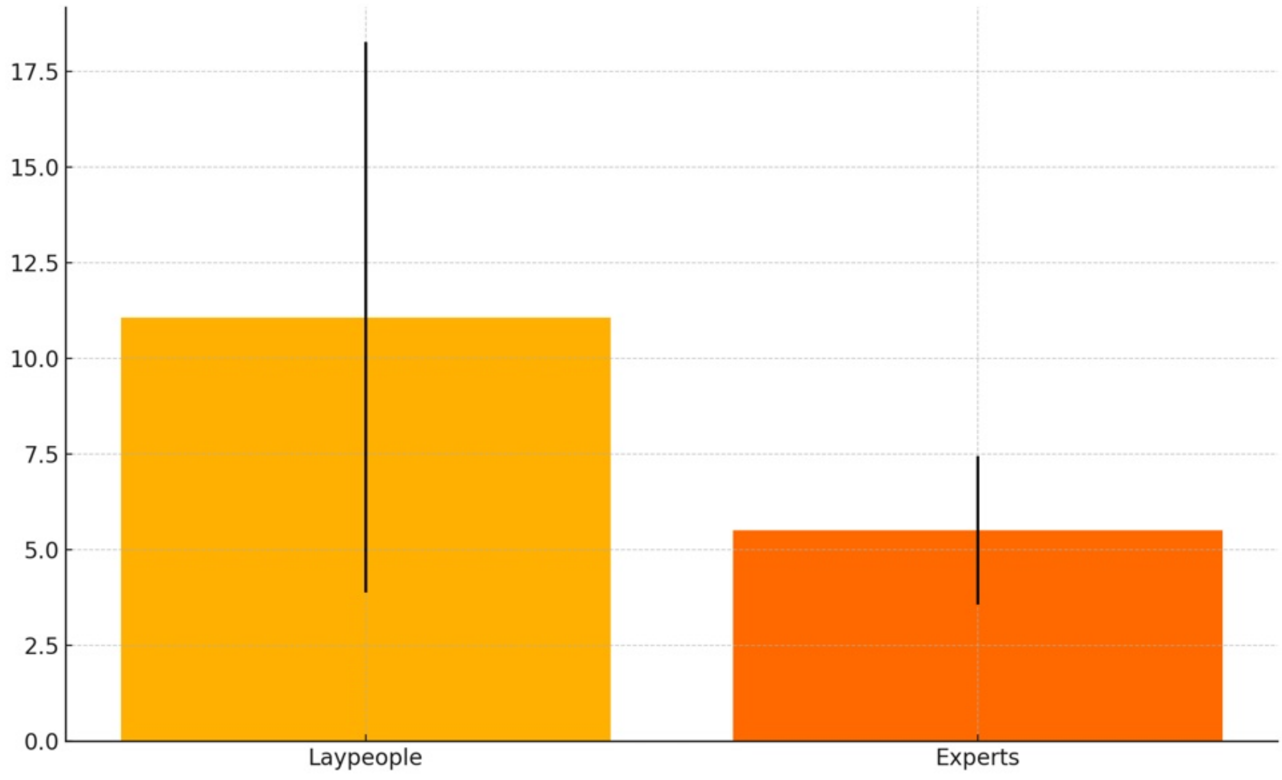

Figure 5. Ratio between word count and flavor descriptions

precisely in relation to the task description, indicating higher codability for the experts. The results are shown in Figure 5, where a lower value indicates higher precision. Worth noticing is the extensive standard deviation in the laypeople group, particularly affected by one of the participants showing a deviant behavior. This participant had a mean average of 2.83 words per taste specific description, which can be compared to the overall mean of 11.08 in the laypeople group. Producing very few both words and target lemmas, this participant could have perhaps misunderstood the task and might be considered to be an outlier. However, due to the limited number of participants, the data from this participant was kept nonetheless.

Concerning the stimuli conditions in this context: The ratio between words and taste descriptors was practically identical between Drink and Solid Food in both groups (laypeople = 10.23, 10.42, experts = 3.84, 3.99). What stood out was the Image condition, being distinctly higher in both groups (laypeople = 12.59, experts = 5.70). Since this pattern repeated itself independently within each group, with a similar deviation, there might be reason to believe that this is not a coincidence and that the Image condition on a more general level provokes less precise descriptions. The differences are shown in Figure 6.

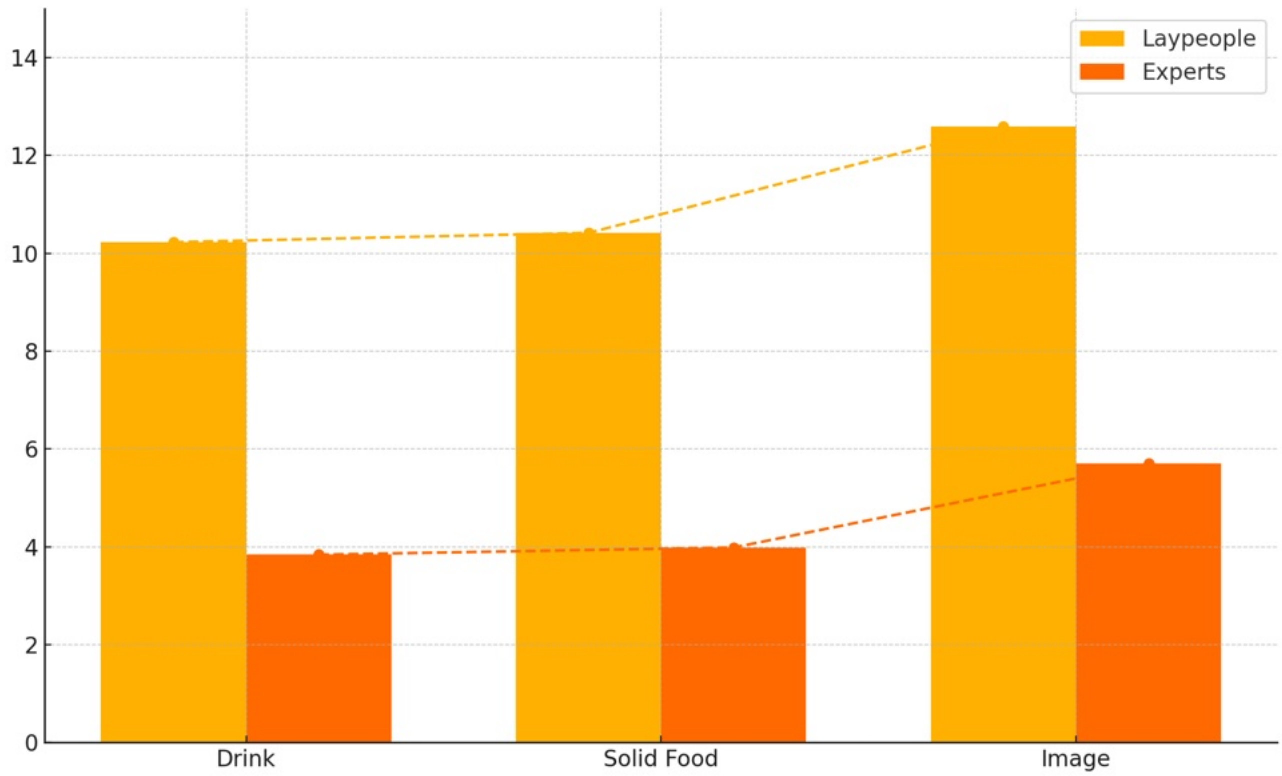

Figure 6. Ratio between word count and flavor descriptions divided by stimuli conditions

4.3 Agreement

Do the different groups show a significant difference in agreement?

Although the average agreement in basic taste words was slightly higher for the experts (*M* = 3.14 *SD* = 1.68) than the laypeople (*M* = 2.62 *SD* = 1.58) the difference was not found to be significant ($t(51) = 1.44$, $p = .156$). This means that the measured agreement only gave indirect support in favor for the experts in the codability measure. The values are shown in Figure 7 where the *5* in the y-axis represents total agreement across all unique combinations. Overall, the expert group used a larger amount of basic taste words than the laypeople group (90 vs 78) and contributed with a slightly broader variation of combinations to the data set (27 vs 26). Moreover, the agreement between the groups sometimes differed in a qualitative sense. For example, all five participants in the expert group identified UMAMI when describing parmesan cheese and tomato juice. In contrast, none of the participants in the laypeople group used the term UMAMI for any of the products.

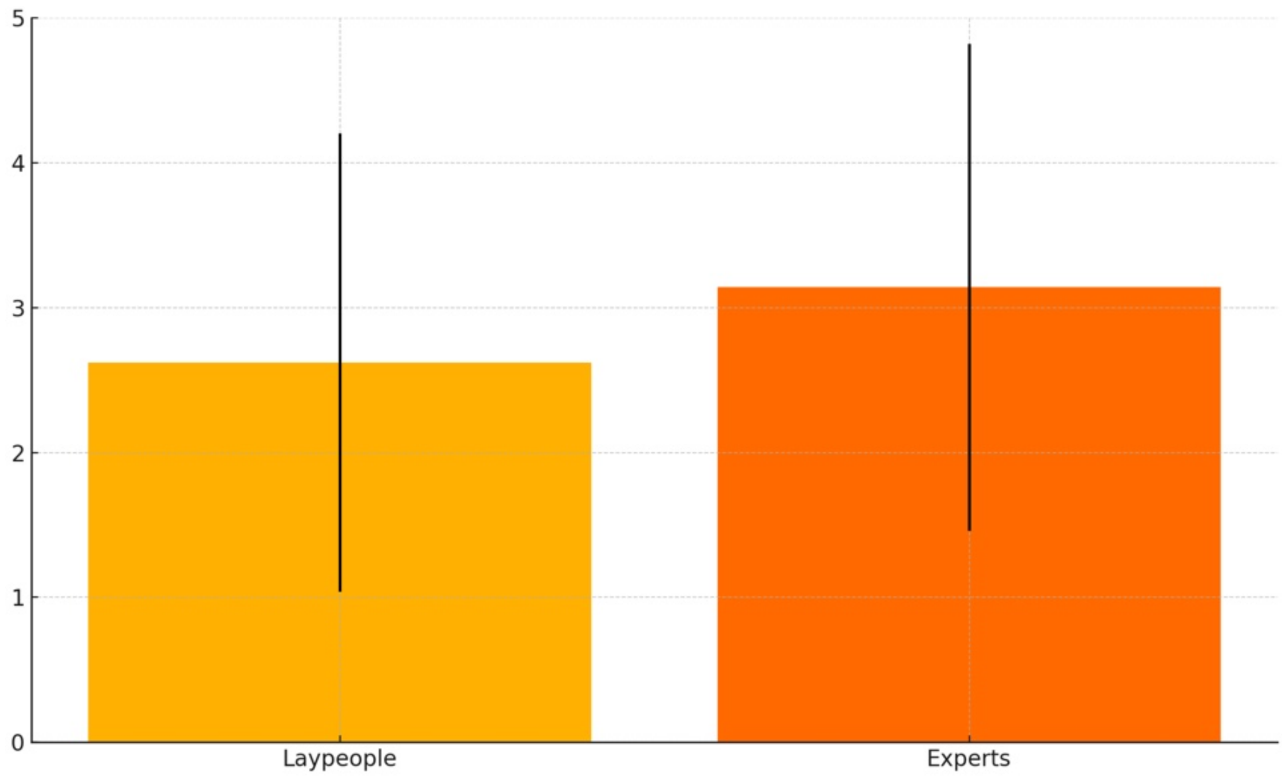

Figure 7. Average agreement in basic taste words

4.4 Target response time

Do the different groups show a significant difference in their average target response time?

The experts (*M* = 19012ms, *SD* = 10897ms) showed a higher mean target response time than the laypeople (*M* = 15415ms, *SD* = 7645ms). Although the difference was notable, the null hypothesis could not be excluded ($t(88) = -1.81$, $p = .074$). Thus, this measurement showed a slight advantage for higher codability in the laypeople group, but no direct support. The results are shown in Figure 8.

Looking into the relationship between target response time and stimuli conditions, the Solid Food condition stood out, with longer target response time in both groups. This was clearly because these stimuli had to be chewed and swallowed, which prevented participants giving a quick answer if they did not want to speak with food in their mouths. Since the Solid Food condition had this restraining effect, it is hard to compare in any direction. For this reason, we can exclude Solid Food and instead compare Drink and Image. The laypeople showed a similar mean average within these conditions, and the experts and laypeople performed almost identical in relation to the Drink condition. The Image condition stood out in the expert group (*M* =

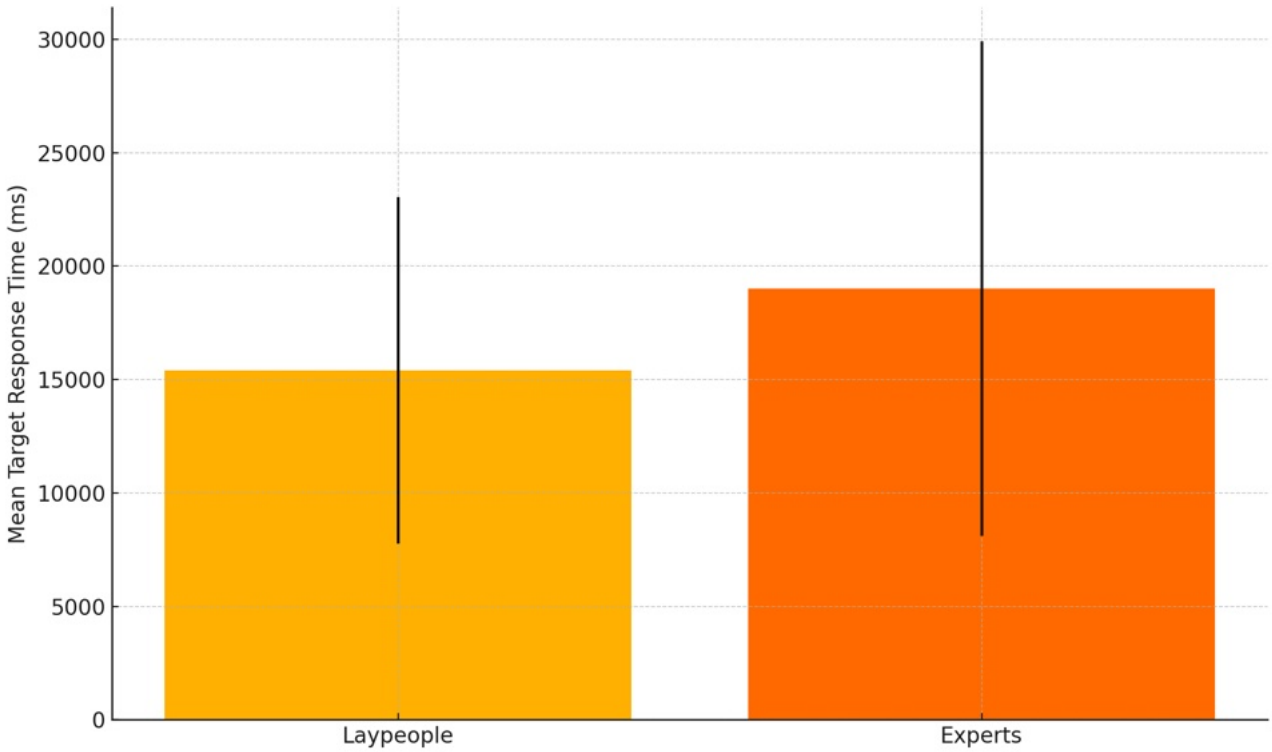

Figure 8. Mean average in target response time

18951ms, *SD* = 12042ms) with a longer mean target response time than the laypeople (*M* = 13549ms, *SD* = 4656ms). Although the difference was notable, there was no significant effect ($t(28) = -1.62$, $p = .116$). The reason might be due to the extensive standard deviation, particularly prominent in the expert group. Figure 9 shows the results divided for the different stimuli conditions.

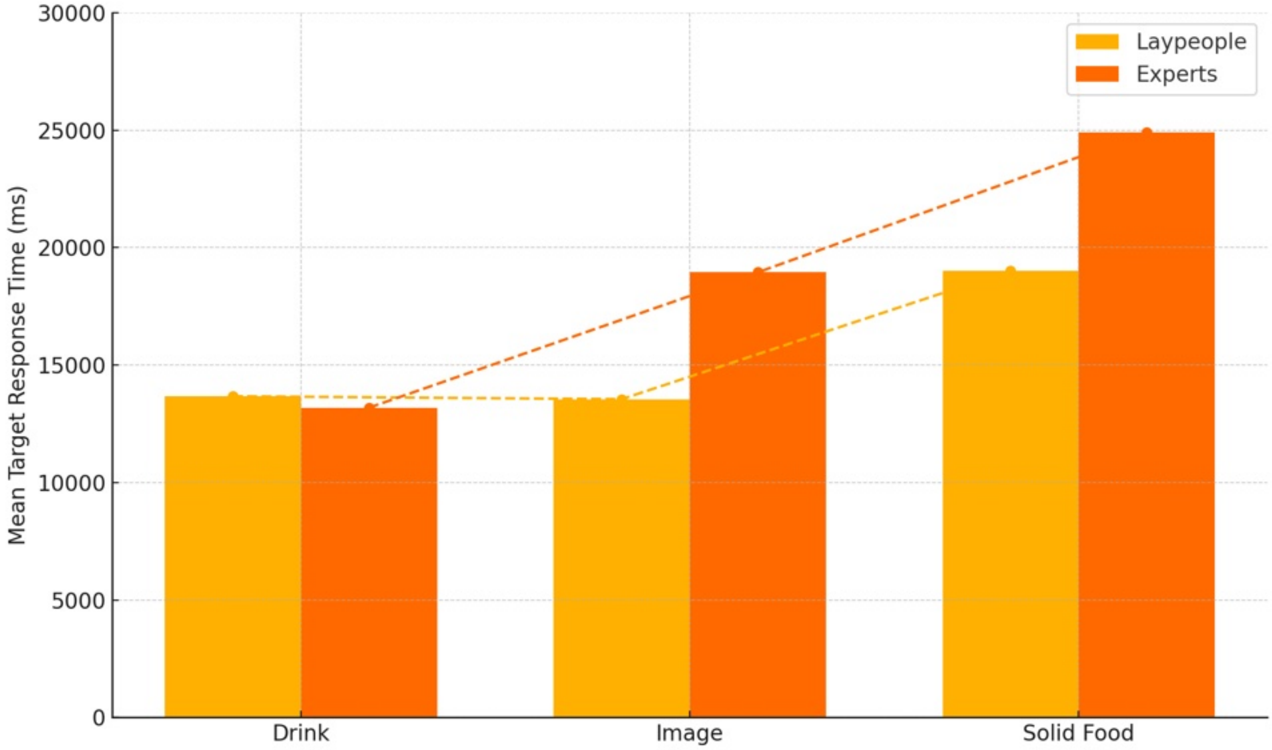

Figure 9. Mean target response time divided by stimuli conditions

4.5 Summary

Significant differences between experts and laypeople were found in four places:

1. **Use of semantic categories** - There was a significant difference to be found in what kind of semantic categories the groups used in their descriptions. Both groups mainly used Abstract descriptions to a similar proportion, meaning that the differences lay in the other categories. Experts relayed more on Source descriptions, while laypeople showed a wider spread.
2. **Defining taste** - When combining the semantic categories to two overt categories, representing the conditions *flavor specific* and *non flavor specific*, the experts were more likely to use the former and the laypeople more likely to use the latter. This means that the

experts were better at following the task descriptions and isolating flavor from other sensory input.

3. **Answering length** - The laypeople used significantly more words than the experts, showing higher codability for the experts
4. **Answering precision** - When comparing the amount of words to the amount of flavor descriptions, significantly lower values were found for the experts, indicating that the experts used their words more precise in relation to the task. Thus, lending support for higher codability among the experts.

Other notable findings:

- There was a non-significant correlation in both groups for using less efficient descriptions in relation to the stimuli condition Image.
- The groups showed a notable qualitative difference in the use of the basic taste term umami.
- The experts were slightly slower in their responses, most notably in the Image condition.

5. Discussion

In this Section the results are discussed. In Section 5.1 answers to the research questions posed in Section 1.1 are provided. Section 5.2 discusses the results in relation to GCM.

5.1 Research questions

1. The different groups showed significant differences in their use of semantic categories.

Given the fact that both experts and laypeople mostly used Abstract descriptions to a similar extent, no clear implication of higher codability was found in either of the groups. Abstract flavor terms were not affected by level of expertise. Instead, the experts produced more Source descriptions. The same kind of pattern was observed by Croijmans & Majid (2016), where wine and coffee experts conveyed more to Source descriptions in their own area of expertise than a control group of laypeople. This indicates that the Source category may be more productive than the Abstract category is. The reason could be in the nature of the descriptions: Abstract terms like 'sweet' or 'exotic' have an arbitrary semantic content. The meaning of these kind of words would need to be established and agreed upon within a language community in order to be understood. Source descriptions like 'apple' or 'cherry' on the other hand, rely on an already established reference point. Therefore, they could more easily be understood right away. This could also explain why, for example, wine experts are known for their often creative Source descriptions, describing wine as tasting like 'petrol', 'hay', or 'old leather'. It could also be argued that a Source description is more exact compared to an Abstract description, using a very specific frame of reference instead of a wider, feature-oriented one. Since the experts were used to the task of describing flavor, they might have developed this habit in order to improve precision and clarity in their descriptions.

Furthermore, the results showed that the laypeople to a lesser extent followed the task description and had a harder time producing descriptions of flavor explicitly. In sensory evaluation research, flavor and texture are clearly separated and professional work in a sensory panel means that one often has to distinguish between flavor and texture attributes. This fact most certainly contributed to the notable differences in the use of flavor terms. Revisiting the five sense model, it seems like the experts were better at making the division between the senses, while the laypeople made more holistic judgments of the gustatory input. Lacking insight and experience on the area, the laypeople might have been less aware of the multimodal nature of gustatory experiences. When asked to provide flavor specific descriptions they either did not understand the task or were not capable of making the distinction.

2. The different groups showed a significant difference in answering length.

The experts used fewer words per description than the laypeople. According to the codability measure, shorter answers indicate higher codability. In the current study, this assumption might be a bit problematic. As previously stated, codability as theoretical concept originates from the field of typological linguistic research, mapping out broad and general patterns between languages. The kind of stimuli used is traditionally very simple and set up to elicit basic cross-linguistic lexical patterns, for example basic color words in the original works of Brown & Lenneberg (1954) or words for basic tastes and smells in the later adaption by Majid et al. (2018) and Majid & Burenhult (2014). In this respect, codability is an idealized model that works best when the stimuli and answers are simple and highly controlled. The current study was not about identifying basic tastes, but rather expected participants to provide detailed and vivid descriptions of complex compilations of flavor. Under these circumstances, word count is perhaps not the best way to measure codability, since a short Abstract description might not be the most efficient way to communicate the experience of an advanced flavor stimuli. A detailed description perhaps needs to be a bit longer and include comparisons and nuances in order to be informative. Croijmans & Majid (2016), who applied codability under similar circumstances also recognized this issue and suggested that agreement between speakers is a more informative part of the codability measure than answering length when eliciting descriptions rather than using a simple naming task. They also acknowledge the fact that codability does not evaluate how informative the descriptions might be. Examples are brought up that indicate that experts use a more articulate language, but this distinction seems to slip under the radar of codability. The current study addressed this issue by introducing answering precision as an additional parameter.

3. The different groups showed a significant difference in answering precision.

This measure was introduced in the current study as a complement to the codability measure in order to examine how informative and efficient the descriptions provided by the different groups were. As it turned out, the expert group used a more precise language than the laypeople in relation to the task. The experts used a larger vocabulary for describing flavor, but still provided answers using fewer words. This highlights yet another way in which training in sensory evaluation can influence gustatory descriptions.

4. The different groups did **not** show a significant difference in agreement.

The experts showed a slightly higher level of agreement, indicating higher codability, but the effect did not reject the null hypothesis. Despite of the fact that no significant quantitative difference in agreement between the groups was found — lending no support for variation in codability — an interesting qualitative difference was noted, namely the use of the basic taste term umami. While all experts used umami to describe both tomato juice and parmesan cheese, it was not used a single time by the laypeople. Considering the limited amount of basic taste terms available, the fact that the laypeople seemed to lack one of them is quite striking. Although discovered over a century ago, umami is the most recently recognized basic taste. It was confirmed within the scientific community in the 1980s but has only gained widespread acceptance among the general public in recent years (Fredholm 2008). Even though most people are aware of the existence of umami, it still seems to represent a dividing line in language use between experts and laypeople.

5. The different groups did **not** show a significant difference in target response time.

This was the only measure lending support for higher codability in the laypeople group. The effect was not significant but close to the threshold (p = .074). The reason can partly be linked to the stimuli conditions. As already mentioned, the Solid Food condition likely generated longer response times due to chewing and swallowing preventing the production of speech. These factors could be distributed very differently on an individual level and are very hard to draw any conclusions out of. The experts answers were indeed considerably longer in the Solid Food condition, tilting the mean values to the detriment of the expert group. In the Drink condition, the values were similar between the groups. The difference found in the Image condition will be discussed more in Section 5.2, addressing GCM.

In sum, the results showed that expertise does influence how gustatory experiences are encoded linguistically, particularly in terms of lexical precision and the use of specific flavor terms. However, the variation observed within both groups indicates that expertise alone does not fully explain the differences. While experts generally provided more structured and precise descriptions, similarities in agreement and response times as well as individual variation within both groups suggests that additional factors may influence how flavor is expressed. The high standard deviation in both precision, agreement and target response times across both groups further implies that the differences might be more individual. Some laypeople responded as quickly and precisely as experts, while some experts exhibited very long response times and relied on less precise descriptions. Individual factors such as cognitive processing speed, linguistic confidence, or the challenge of formulating answers in a controlled setting may contribute to these differences.

Another point to mention is that the experts all stated the maximum value of 6 in level of interest in gastronomy/foods/drinks in the questionnaire (see Section 3.1). The laypeople on the other hand had a mean value of 3.2 (SD = 1.1) on the same point. It could be that the differences between experts and laypeople had more to do with the level of interest than the actual knowledge or expertise. Having a higher degree of interest might also have made the experts more motivated when performing the task.

5.2 Addressing GCM

So far it has been established that some significant differences can be observed between experts and laypeople in gustatory language, mainly regarding the use of semantic categories, answering length and answering precision, lending partial support for higher codability among the experts. The reason for this could be linked to the fact that the experts were more used to making gustatory descriptions and had developed strategies to overcome any anticipated obstacles. Through their experience, they generally managed to structure the information more efficiently and provided shorter and more precise answers. They were more familiar with the fact that gustatory experiences are multimodal and therefore found it more natural to make the distinction between different sensory input. These explanations are sufficient on a more superficial level. However, what has not yet been touched upon is the deeper underlying causes of the differences. What does it mean to articulate a sensory experience in words and how exactly would training in sensory evaluation affect this ability?

One way to approach this question is by using GCM as a theoretical framework. In order to do so, the method in the current study was adapted to include not only gustatory stimuli but also visual representations of food products. This stimuli condition required the participants to mentally simulate or “translate” the experience from one sense to another, i.e from the visual to the gustatory modality. As previously stated in Section 2.3.2, the relationship between language, mental simulation and neurological activation plays a central role in GCM. Something that needs to be addressed though, is that previous research providing support for the GCM in the gustatory domain has predominantly been focused on *language perception* (Speed & Majid 2020; Grabenhorst, Rolls & Bilderbeck 2008). In relation to *language production*, the empirical support is a lot more scarce. Therefore, no particular hypothesis or questions were constructed regarding GCM. The idea was rather to observe any pattern that might emerge and then discuss this from a GCM perspective. Two notable findings were made in relation to the Image condition:

(a) There was a weak correlation, but still noticeable correlation in both groups for using less precise descriptions.
(b) The experts were slightly slower in their responses.

Starting with (a), the results showed a deviant pattern for both of the groups in the Image condition when measuring the ratio between word count and taste specific descriptions (see Figure 5). Both groups used more words relative to the amount of taste descriptors when describing images compared to actual flavor. The language was in that respect less precise and more vague with respect to the task. First of all, this indicates that there might be a difference on a more general level in the ability to provide linguistic output when describing actual taste stimuli vs mental simulations of taste, to the detriment of mental simulations. Previous research supporting GCM does not propose this to be a one-to-one relationship. It is rather believed that semantic representations consists of weaker overlaps and entanglements with actual experience (Khateb et al. 2002; Pulvermüller 2005). In this respect, the slightly lower efficiency in the Image stimuli goes well together with the GCM paradigm. Especially interesting is how the pattern repeated itself independently on different levels within each group.

Concerning (b), it is harder to find any connections between the results and the GCM. The Drink condition provided almost equal target response time between the groups, while the experts were slightly slower in the Image condition[4] (see Figure 8). A speculative explanation could be that the experts mental simulations presumably were more deeply linked to a wider range of experience, which means it took them longer time to process and this lead to slower target response times.

[4] Because of external factors already discussed regarding the Solid Food condition, it is not taken into account.

6. Conclusions and future research

This study set out to examine how Swedish laypeople and trained sensory experts linguistically encode taste experiences. The results suggest that expertise has an impact on the ability to describe flavor, particularly in terms of precision, lexical variation, and the ability to isolate flavor-specific attributes from other sensory impressions. Experts tended to use a more structured vocabulary and relied more on Source descriptions, while laypeople showed a broader distribution across semantic categories. However, an important observation is that notable variation was present within both groups. While experts appears to use a more efficient and precise language, the differences were not entirely categorical. Some laypeople exhibited structured and articulate descriptions, while some experts relied on broader, less specific formulations. This suggests that individual factors—such as level of interest in gastronomy and linguistic confidence—may also influence how taste experiences are put into language. Future research could explore these individual differences in more depth by running a similar experiment with larger set of participants. A fruitful direction might be to examine laypeople with and without personal engagement with food-related experiences (e.g. culinary hobbies), to see how this affects the ability to describe flavor.

As discussed in Section 5.3, codability is not ideally suited for measuring how informative and "correct" a more complex description might be. This was partially addressed in the current study by expanding the codability measure to assess precision beyond word count. However, to measure the correctness of answers would require a more targeted method. Croijmans & Majid (2016) addresses the same point and propose "conducting a director-matcher task, where people have to match wines and coffees to descriptions" (2016: 17). This might be one way for future research to refine and expand the codability measure.

To further explore the relationship between GCM, gustatory experiences and language, more empirical work could be done to address this paradigm. GCM might suggest that training and experience contributes to a wider and more diversified semantic repertoire, allowing for more precise and structured descriptions. It would be especially rewarding to further compare taste and smell with other presumably more dominant, sensory domains (e.g vision). This could target whether there is a qualitative difference in how input from different senses affect language comprehension and production.

By refining methods for analyzing precision and consistency in sensory descriptions, future studies can contribute to linguistic theories on embodiment and meaning while also benefiting interdisciplinary fields such as sensory evaluation and food communication.

Understanding how people put gustatory experiences into words is not just a matter of linguistic variation—it sheds light on the intricate relationship between perception, expertise, and language itself. The findings of this study suggest that expertise refines and structures gustatory descriptions, but individual differences still play a crucial role. This underscores the need for a more nuanced perspective on how language and experience interact in sensory domains.

Ultimately, the way we describe flavor is more than just words, it reflects how we perceive, structure, and share our sensory world!

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Appendix 1: Consent form

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Medgivande

Jag samtycker härmed till att delta i studien "smakbeskrivande språk" och tillåter att mina svar spelas in med både ljud och video. Jag samtycker även till att mina transkriberade svar, samt de anonyma uppgifterna i det bifogade frågeformuläret, används för att sammanställa resultat och statistik i en vetenskaplig undersökning beträffande hur smakupplevelser kan gestaltas med språkliga medel. Undersökningen är en del av en kandidatuppsats i allmän språkvetenskap men materialet för denna studien kan även komma att användas som underlag till framtida uppsatser och/eller vetenskapliga artiklar.

Deltagandet är anonymt och inga namn eller andra personliga uppgifter kommer att publiceras i något sammanhang. Det filmade och inspelade materialet kommer inte att spridas eller användas i något annat syfte än ovan nämnda vetenskapliga studier. Enskilda citat från svaren kan komma att presenteras i färdiga studier men isåfall helt anonymiserat.

Enligt svensk lag kan du i efterhand ångra ditt deltagande och närsomhelst höra av dig och få samtliga uppgifter och inspelningar raderade. Datan kommer därför lagras på ett sådant vis att det är möjligt att spåra medgivandet till datan.

Datum, ort | Underskrift

_________________________ | _________________________

Deltagarnummer:

"Smakbeskrivande Språk"

Ture Berg: 0736699469, tureberg@live.se
Handledare Johan Blomberg: 046–222 99 02, johan.blomberg@ling.lu.se

Förutom ovan nämnda villkor samtycker jag även till att korta avsnitt av film och ljud från min medverkan får lov att visas upp under presentationer i olika akademiska sammanhang, på symposier samt på vetenskapliga konferenser.

Underskrift

____

Förutom ovan nämnda villkor samtycker jag även till att stillbilder från videomaterialet får användas i uppsatser och/eller vetenskapliga artiklar.

Underskrift

____

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Uppgiftsbeskrivning

Tack för att du valt att medverka i denna vetenskapliga studie som undersöker smakupplevelsens relation till språket. Uppgiften går ut på att beskriva smaker och du kommer att tilldelas totalt nio olika stimuli i följd efter varandra:

- Sex smakprover, både drycker och fast föda. Smakerna ska beskrivas så isolerat som möjligt, utan att refereras till varandra eller till andra sensoriska intryck såsom syn, doft och känsel.
- Tre bilder bestående av olika livsmedel. Du ska föreställa dig smaken av motiven och sedan beskriva den på samma vis som smakproverna.

Proceduren går till på följande vis:

1. Proverna överlämnas till dig av försöksledaren. Bilderna visas upp på avstånd.
2. Inta hela provet på en gång och lämna sedan tillbaks provbehållaren. Bilderna får du betrakta så länge du känner att du behöver för att kunna föreställa dig smaken. Meddela försöksledaren när du känner dig klar.
3. När du känner dig redo att påbörja din beskrivning, vänd dig så du är riktad mot kameran.
4. Ge en så detaljerad beskrivning som möjligt av smaken riktad mot kameran, börja din beskrivning med frasen "det smakar…".
5. Dina svar kommer vid ett senare tillfälle att spelas upp (ljud och video) för en annan grupp testdeltagare. Dessa deltagare ska försöka identifiera och välja ut rätt stimuli bland tio prover med hjälp av dina beskrivningar. Denna gruppen kommer att få proverna i en annan ordning, det är därför viktigt att du inte gör några jämförelser proverna emellan.
6. Innan inspelningen börjar gör vi en eller två testrundor så du blir bekant med rutinen.

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Viktigt att tänka på:

- Använd **inte** namnet på den aktuella produkten i dina beskrivningar.
- Var noga med att endast beskriva den upplevda smaken. Andra sensoriska intryck såsom syn och känsel (konsistens) bör i möjligaste mån uteslutas från beskrivningen.
- Behandla varje prov unikt och referera **inte** till tidigare prover.
- Vid beskrivning av bilderna undvik formuleringar som "jag tror/föreställer mig att det smakar…". Behandla dem istället som de andra proverna, dvs med frasen "det smakar…".
- Varva varje smakprov med en klunk vatten.

Proverna består av beprövade livsmedel som är kommersiellt tillgängliga, innehållet är alkoholfritt och helt ofarligt. Du kan närsomhelst välja att avbryta ditt deltagande utan att behöva ange någon anledning.

Tack för ditt deltagande!

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Frågeformulär

Vid Ja/Nej-frågor och betygsskala; ringa in ditt svar, annars skriv. Saknas plats kan du fortsätta på baksidan av papperet.

Kön:

Ålder:

Deltagarnummer (skriv inget här):

1. Talar du något annat språk än svenska?

Ja **Nej**

Om ja, vänligen uppge alla språk du kan **i ordning efter dominans**:

1	2	3	4	5

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2. Har du genomgått någon utbildning/träning som inkluderat utvärdering och/eller bedömning av smak? (ex. kurser i vinprovning, kock- eller sommelierutbildning etc.)

Ja **Nej**

Om ja, beskriv kortfattat:

2. Har du någon arbetslivserfarenhet som inkluderat utvärdering och/eller bedömning av smak?

Ja **Nej**

Om ja, beskriv kortfattat:

3. Hur skulle du bedöma ditt eget intresse av gastronomi/mat/dryck, där 1 representerar "inget intresse" och 6 "mycket stort intresse"?

1 **2** **3** **4** **5** **6**

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4. Har du något specialintresse inom gastronomi/mat/dryck?

Ja **Nej**

Om ja, beskriv kortfattat:

Tack för dina svar!

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Appendix 4: Image stimuli

Appendix 5: Raw data

Participant	Stimuli Number	Stimuli Type	Product	Target Response Time (ms)	Word count	TYPE count Taste	Ratio word count/Type count taste	TYPE count Total	ABSTRACT	SOURCE	EVALUATIVE	TACTILE	META DESCRIPTION/ ASSOCIATIONS
L1	A1	Flaska	Havtorn	18409	8	2	4,000	2	2	0	0	0	0
L1	A2	Burk	Parmesan	33222	5	2	2,500	2	2	0	0	0	0
L1	A3	Bild	Citron	13948	5	2	2,500	2	2	0	0	0	0
L1	B1	Flaska	Tranbär	27443	5	2	2,500	2	2	0	0	0	0
L1	B2	Burk	Choklad	39236	5	2	2,500	2	2	0	0	0	0
L1	B3	Bild	Banan	19731	3	1	3,000	1	1	0	0	0	0
L1	C1	Flaska	Tomat	11584	3	1	3,000	1	1	0	0	0	0
L1	C2	Burk	Aprikos	34339	5	2	2,500	2	2	0	0	0	0
L1	C3	Bild	Kaffe	16974	3	1	3,000	1	1	0	0	0	0
L2	A1	Flaska	Tomat	11088	57	8	7,125	12	6	2	0	4	0
L2	A2	Burk	Choklad	27214	50	5	10,000	9	5	0	0	2	2
L2	A3	Bild	Kaffe	8523	56	3	18,667	7	2	0	1	2	2
L2	B1	Flaska	Havtorn	19181	70	5	14,000	8	3	2	0	1	2
L2	B2	Burk	Aprikos	10314	61	4	15,250	9	2	1	1	3	2
L2	B3	Bild	Citron	15235	64	6	10,667	8	5	0	1	0	2
L2	C1	Flaska	Tranbär	10360	90	5	18,000	11	2	1	2	0	6
L2	C2	Burk	Parmesan	13182	113	5	22,600	12	5	0	1	3	3
L2	C3	Bild	Banan	25486	178	5	35,600	10	4	0	0	4	2
L3	A1	Flaska	Havtorn	18254	72	4	18,000	6	2	2	0	0	2
L3	A2	Burk	Aprikos	20079	41	4	10,250	5	2	2	0	1	0
L3	A3	Bild	Kaffe	10882	62	5	12,400	6	5	0	0	0	1
L3	B1	Flaska	Tranbär	17414	78	6	13,000	8	4	2	0	0	2
L3	B2	Burk	Parmesan	15592	28	6	4,667	6	6	0	0	0	0
L3	B3	Bild	Citron	8654	48	3	16,000	4	3	0	0	0	1
L3	C1	Flaska	Tomat	13599	45	3	15,000	3	2	1	0	0	0
L3	C2	Burk	Choklad	19513	71	4	17,750	5	2	2	0	0	1
L3	C3	Bild	Banan	10775	40	2	20,000	3	2	0	0	1	0
L4	A1	Flaska	Tranbär	7387	55	6	9,167	6	4	2	0	0	0
L4	A2	Burk	Choklad	3180	53	5	10,600	7	4	0	1	1	1
L4	A3	Bild	Citron	9329	65	5	13,000	6	4	0	1	0	1
L4	B1	Flaska	Havtorn	3061	90	9	10,000	11	5	2	2	1	0
L4	B2	Burk	Aprikos	6809	128	6	21,333	10	4	1	1	1	3
L4	B3	Bild	Banan	14225	91	5	18,200	9	4	0	1	3	1
L4	C1	Flaska	Tomat	9132	69	4	17,250	6	4	0	0	1	1
L4	C2	Burk	Parmesan	13017	114	6	19,000	9	4	1	0	2	2
L4	C3	Bild	Kaffe	12237	82	5	16,400	5	5	0	0	0	0
L5	A1	Flaska	Tomat	13720	36	4	9,000	5	4	0	0	0	1
L5	A2	Burk	Parmesan	16882	18	4	4,500	5	4	0	0	0	1
L5	A3	Bild	Banan	8753	38	5	7,600	5	5	0	0	0	0
L5	B1	Flaska	Havtorn	13715	49	5	9,800	5	4	0	0	0	1
L5	B2	Burk	Aprikos	17930	41	6	6,833	6	4	2	0	0	0
L5	B3	Bild	Citron	13989	23	6	3,833	6	6	0	0	0	0
L5	C1	Flaska	Tranbär	10750	18	5	3,600	5	5	0	0	0	0
L5	C2	Burk	Choklad	14865	30	5	6,000	7	5	0	0	2	0
L5	C3	Bild	Kaffe	14498	40	5	8,000	6	5	0	0	1	0
Total				693710,000	2306,000	194,000	498,592	266,000	157,000	23,000	12,000	33,000	40,000
Mean				15415,778	51,244	4,311	11,080	5,911	3,489	0,511	0,267	0,733	0,889
SD				7645,114	37,705	1,794	7,186	3,036	1,471	0,815	0,539	1,156	1,210
Flaska Total				205097,000	745,000	69,000		91,000	50,000	14,000	4,000	7,000	15,000
Flaska Mean				13673,133	49,667	4,600	10,229	6,067	3,333	0,933	0,267	0,467	1,000
Burk Total				285374,000	763,000	66,000		96,000	53,000	9,000	4,000	15,000	15,000
Burk Mean				19024,933	50,867	4,400	10,419	6,400	3,533	0,600	0,267	1,000	1,000
Bild Total				203239,000	798,000	59,000		79,000	54,000	0,000	4,000	11,000	10,000
Bild Mean				13549,267	53,200	3,933	12,591	5,267	3,600	0,000	0,267	0,733	0,667
P1	A1	Flaska	Tranbär	8340	36	9	4,000	9	3	6	0	0	0
P1	A2	Burk	Parmesan	7728	50	10	5,000	10	7	3	0	0	0
P1	A3	Bild	Kaffe	8062	21	6	3,500	6	6	0	0	0	0
P1	B1	Flaska	Havtorn	12700	41	7	5,857	7	2	5	0	0	0
P1	B2	Burk	Choklad	13610	50	9	5,556	9	7	2	0	0	0
P1	B3	Bild	Citron	7525	20	5	4,000	6	4	1	0	1	0
P1	C1	Flaska	Tomat	15559	23	8	2,875	8	4	4	0	0	0
P1	C2	Burk	Aprikos	18193	20	5	4,000	5	2	3	0	0	0
P1	C3	Bild	Banan	4247	37	4	9,250	4	4	0	0	0	0
P2	A1	Flaska	Tomat	11496	27	6	4,500	6	5	1	0	0	0
P2	A2	Burk	Parmesan	18360	50	11	4,545	12	8	3	0	0	1
P2	A3	Bild	Banan	36160	29	4	7,250	5	4	0	0	0	1
P2	B1	Flaska	Havtorn	11906	35	8	4,375	8	6	2	0	0	0
P2	B2	Burk	Aprikos	12517	35	7	5,000	7	3	4	0	0	0
P2	B3	Bild	Citron	23800	13	4	3,250	4	3	1	0	0	0
P2	C1	Flaska	Tranbär	15515	26	8	3,250	8	5	3	0	0	0
P2	C2	Burk	Choklad	23450	18	6	3,000	7	4	2	0	0	1
P2	C3	Bild	Kaffe	46592	11	3	3,667	3	3	0	0	0	0
P3	A1	Flaska	Havtorn	9758	17	6	2,833	6	6	0	0	0	0
P3	A2	Burk	Choklad	36890	19	4	4,750	6	4	0	0	2	0
P3	A3	Bild	Banan	20547	30	3	10,000	4	2	1	0	1	0
P3	B1	Flaska	Tranbär	17335	20	3	6,667	3	3	0	0	0	0
P3	B2	Burk	Aprikos	26232	28	5	5,600	6	4	1	0	1	0
P3	B3	Bild	Kaffe	16895	37	7	5,286	8	6	1	0	0	1
P3	C1	Flaska	Tomat	18601	30	6	5,000	6	6	0	0	0	0
P3	C2	Burk	Parmesan	29895	13	4	3,250	5	3	1	0	1	0
P3	C3	Bild	Citron	17159	31	4	7,750	5	4	0	0	0	1
P4	A1	Flaska	Tranbär	13782	9	5	1,800	6	5	0	0	1	0
P4	A2	Burk	Aprikos	32647	12	4	3,000	4	3	1	0	0	0
P4	A3	Bild	Banan	27394	13	2	6,500	4	1	1	0	1	1
P4	B1	Flaska	Havtorn	12900	18	5	3,600	5	4	1	0	0	0
P4	B2	Burk	Parmesan	35151	15	5	3,000	5	3	2	0	0	0
P4	B3	Bild	Kaffe	29235	25	3	8,333	5	3	0	0	0	2

Participant	Stimuli Number	Stimuli Type	Product	Target Response Time (ms)	Word count	TYPE count Taste	Ratio word count/Type count taste	TYPE count Total	ABSTRACT	SOURCE	EVALUATIVE	TACTILE	META DESCRIPTION/ ASSOCIATIONS
P4	C1	Flaska	Tomat	17445	16	5	3,200	6	3	2	0	0	1
P4	C2	Burk	Choklad	55454	15	5	3,000	5	3	2	0	0	0
P4	C3	Bild	Citron	19070	25	4	6,250	5	4	0	0	0	1
P5	A1	Flaska	Tomat	8994	14	5	2,800	5	5	0	0	0	0
P5	A2	Burk	Choklad	23248	17	7	2,429	7	2	5	0	0	0
P5	A3	Bild	Kaffe	7608	18	5	3,600	5	5	1	0	0	0
P5	B1	Flaska	Havtorn	13265	20	6	3,333	6	3	3	0	0	0
P5	B2	Burk	Parmesan	15701	18	6	3,000	6	3	3	0	0	0
P5	B3	Bild	Banan	11511	16	4	4,000	4	1	3	0	0	0
P5	C1	Flaska	Tranbär	10175	14	4	3,500	4	2	2	0	0	0
P5	C2	Burk	Aprikos	24436	28	6	4,667	6	3	3	0	0	0
P5	C3	Bild	Citron	8456	17	6	2,833	6	2	4	0	0	0
Total				855544	1077	249		267	173	77	0	8	10
Mean				19012,089	23,933	5,533	4,508	5,933					
SD				11133,954	11,131	2,093	1,943	2,007					
Flaska Total				197771,000	346,000	91,000		93,000	62,000	29,000	0,000	1,000	1,000
Flaska Mean				13184,733	23,067	6,067	3,839	6,200					
Burk Total				373512,000	388,000	94,000		100,000	59,000	35,000	0,000	4,000	2,000
Burk Mean				24900,800	25,867	6,267	3,986	6,667					
Bild Total				284261,000	343,000	64,000		74,000	52,000	13,000	0,000	3,000	7,000
Bild Mean				18950,733	22,867	4,267	5,698	4,933					