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English and Swedish Color Terms:

An Investigation of Common Color Terms, Prototypes, and Color Boundaries in English and Swedish

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Abstract

In a study by Brent Berlin & Paul Kay from 1969 it was found that there are 11 basic color terms and 7 stages of color evolution. Since then, there have been many follow-up studies within the field to confirm or deny this finding. Some have argued against only including 11 terms in the category of *basic* while others have criticized the criteria they used for basicness. Some have proposed that there is a connection between a country's technological development and the amount of basic color terms they use while others claim that these evolutionary stages do not exist at all. Because of this, some critical questions for the field are whether color is semantically universal or relative in the world's languages and if the maximum amount of basic color terms in a language truly is only 11. This research aims to compare the most frequently used color terms in English and Swedish, the prototypes for each of these, and the boundaries between the basic color terms in these two languages. By comparing two languages that are close geographically and genealogically similar, a case can be made for whether there is a connection between color usage and technological development and if languages at the final stage of Berlin & Kay's (1969) evolutionary stages encode color in the same manner. This was done using a free elicitation task, a prototype task, and a boundary task with the Munsell Color Chart as a stimulus, all classic methods in color terminology research. The data from these tasks shows that while English and Swedish have the same basic color terms, there are differences in the prototypes and boundaries between these colors. For example, the colors *red/röd* and *blue/blå* have the same prototype in the two languages while *pink/rosa* and *brown/brun* have different ones. Most of the basic color terms also have very similar boundaries in Swedish and English with the exceptions of *brown/brun* and *yellow/gul*. Overall, Swedish speakers display less consensus in how they encode color than English speakers. This result allows for arguments for both universalism and relativism, but above both theories, the results support that color terminology and its encodement is subject to a lot of individual differences. The results of the study also suggest that there are secondary colors in both English and Swedish, *turquoise/turkos, maroon,* and *beige,* that could potentially be included in the category of basic colors. Further studies should be conducted on whether these terms should be considered basic based on whether speakers include them in other basic color terms or not. More research of technologically advanced societies should also be done to discover more about how the color space is encoded by means of basic color terminology.

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Abbreviations

WCS – World Color Survey

NCS – Natural Color System

1.Introduction

As our world grows ever more global, people from different countries and cultures will interact in all types of different situations whether during travel, while studying, or in a professional work setting. During these interactions, communication is key and while we might be able to translate what someone is saying, truly understanding its meaning is not always straightforward. There is always a level of cultural understanding involved when speaking with someone from another country. An example of a domain where confusion could occur is color. While there is evidence for the fact that all humans with a normal trichromatic color vision have the same physiological basis for color vision (Jordan & Mollon, 1997), the terms languages use to define color differs greatly. Most languages of the world use a range of terms to describe colors but like all other words, these are subject to change over time. Despite this, a small number of these color terms are shared and comprehended by most speakers of a language. Any color term that fulfills this can be labeled a *basic color term* (Mylonas & MacDonald, 2025). Some languages use as few as 2 basic color terms, while others use up to 11 terms (Berlin & Kay, 1969; Davies & Corbett, 1997), but determining how many and which terms are basic in a language is difficult because of the specific criteria and tests needed. Despite these differences in number of terms, there are many generalities that can be found across the languages of the world, such as the fact that all languages use the same color space, but a different number of terms to label it. There are also similar focal areas for each term (Berlin & Kay, 1969). It appears that languages tend to gravitate to an optimal set of categories and there is even evidence to suggest that there is a greater variation between individuals of the same language than those with different languages (Mylonas & MacDonald, 2016). These findings eventually led to the proposal of semantic universals in the cognitive categorization of color (Heider & Olivier, 1972). Universalists believe that since all humans have the same biology, the development of color terminology has universal constraints. The opposing camp to this is the relativists who believe that colors are culture-specific because of the great variability that can be found cross-culturally. This originates from the Sapir-Whorf hypothesis which presents the notion that a language's structures influence and shape a speaker's cognition (Ottenheimer, 2009). The core question in this debate is whether our thoughts and the way we perceive the world are shaped

by language, or if it is independent of it. Does our language shape the way we perceive and think about, for example, color?

Among the great number of studies that have been published since Berlin & Kay (1969) proposed the existence of semantic color universals, the majority seems to have focused on smaller, less technologically advanced societies and their languages (Sivik & Taft, 1997). These have long been undocumented in the domain of color meaning that such research is invaluable in the quest to determine if *all* the world's languages truly do encode and use color within the framework proposed by Berlin & Kay (1969). However, this has led to fewer conclusions being drawn about the similarities and differences between larger languages, and some languages in the technologically advanced world have even gone largely understudied. An example of such a language is Swedish, the official language of only one country but spoken by approximately 10 million people (Swedish Institute, 2024). This number places Swedish on the top 100 most spoken languages in the world, yet it is still very understudied in the sense of color terms. Some efforts were made during the 90's to map out the characteristics of Swedish color terms by Sivik & Taft, but since then the Swedish language has undergone a lot of change because of globalization. Additionally, while cases have been made for either universalism or relativism by comparing languages with a large difference in their color term inventory, few have attempted to compare languages that are similar to each other. Roberson et al. (2005) proposed that if there are universals in color, languages with the same amount of color terms should mentally represent color in a similar manner despite differences in environment. They tested this on two languages from two less technologically advanced societies, Himba and Berinmo. Both languages have 5 color terms, but Roberson et al. (2005) found that the categorical perception effects differed greatly between their speakers (Roberson et al., 2005). The question is then whether this is also true for languages with a larger and more developed color inventory. As Swedish and English belong to the same language family, the Germanic branch, they are more similar genealogically and are also spoken quite close to each other geographically. The environment the speakers occupy also shares many similarities. Will these two languages have similar terminology, and if they do, will speakers of those languages encode color in the same way? Berlin & Kay's (1969) stages of color evolution would suggest that two languages at the same stage should be similar, but studies like Roberson et al. (2005) have found this to not be the case.

Studying color and the way humans encode and talk about them, especially basic color terms, has helped our understanding of the interplay between language, culture, and biology greatly. The data from the many studies conducted on color terms has been used for everything from image processing, computer vision, and gamut mapping. Establishing color names and how they are mapped onto the color space have also been found to be helpful in long-term memory and enhancement of color recognition. Properly establishing what the basic color terms are in both English and Swedish and finding that there may be more than 11 would also be useful for the precision of color naming in colorimetric color spaces and for facilitating color communication within and between different cultures over global networks (Mylonas & MacDonald, 2016). There are claims in the field that there *should* exist many more than 11 basic color terms since all logical primary color pairs have not been exhausted currently (Kay & McDaniel, 1978). In addition to determining whether Swedish and/or English have more than 11 basic color terms and how well they can potentially fill these primary pairs, the purpose of this study is to provide more data on Swedish color terms since this is still an understudied language for the domain of color. It also aims to determine whether languages that are otherwise similar genealogically also have similar color vocabulary and prototypes for each of the terms. Given the background presented above, the following are the research questions for this thesis:

1. What color terms are most frequently listed by English and Swedish speakers?
2. What are the prototypes for the most frequent color terms and to what extent are they similar in English and Swedish?
3. What differences and similarities are there in the boundaries between the basic color terms in English and Swedish?
4. What are the basic color terms in English and Swedish?
5. Which secondary colors could be included in the basic color category and what evidence is there to support this?
6. How many of the logical primary color pairs can be filled by the color terms listed by speakers of English and Swedish?

Section 2 will provide a general background on the research on color terminology, but also the research done specifically on English and Swedish color terms. Section 3 will describe the method used to collect data on the color terms used in Swedish and English, including the selection of participants, the material used in the experiment and the procedure itself. Section 4 will present the results of the experiments described in section 3. Section 5 will discuss the results presented in section 4 to give it context and answer the research questions based on the results of the data collection.

2. Background

The background will begin by defining some relevant terms and concepts for this study before summarizing the research that has been conducted in the field of color terminology. This will include a detailed summary of the Berlin & Kay (1969) study, the reception of it, and an account of some follow-up studies conducted by different researchers after the Berlin & Kay (1969) study. It also includes a section specifically on the field of color terminology in the English language, and one section for studies on Swedish color terminology.

2.1 Categorization, Prototypes, and Basicness

To study color terms and specifically what constitutes as a *basic* color term one needs to start with categories and why we want to classify objects as belonging to one category or another. Sloutsky (2003) defines the notion of *categories* as "equivalence classes of different (i.e. discriminable) entities" and the act of categorization as "the ability to form such categories and treat discriminable entities as members of an equivalence class" (Sloutsky, 2003, p. 246). Because of the close to infinite number of things in our world, our brains have developed a cognitive tool to compartmentalize this infinite number into a smaller, manageable number known as categorization (Evans & Green, 2006). For example, birds, sports, animals, or colors may be grouped as one *category* of things with several members belonging to it. A robin is a member of the larger category of birds while football is a sport, fox is an animal, and red is a color. Differentiating between these categories can sometimes be the difference between safe or dangerous, for example, color can help us identify traffic lights on the road. When categorizing color, the referent is not a physical object but rather a sensation. We use color terms to label these sensations and assume it to be shared between the members of a language (Mylonas & MacDonald, 2016).

Building on the concept of categories and categorization, Lakoff (1987) proposed the theory of *radial* categories. In this framework, the members of a category are depicted in a circle where the "best" example, the *prototype*, is placed at the center. The other examples are placed further and further from the center the less prototypical they are (Lakoff, 1987). What member of a certain category should be labeled as the prototype may differ from speaker to speaker, but generally the

most salient examples find themselves here. For example, most speakers would think of football and basketball in association with sports before darts or rhythmic ribbon. In studies of color, the term *focal* or *modal* is sometimes used instead. Both focal and prototype in this setting are used to refer to the hue or shade of a specific color that is the most perceptually salient, i.e. the best example of the color term in question. Conklin (1973) describes this as a subregion within each category where, for example, "the bluest blue" is located (Conklin, 1973, p. 938). Research suggests that the color terms that are listed first during elicitation should be considered the basic color terms (Berlin & Kay, 1969).

Defining what *basicness* entails has been attempted by several researchers in different fields, but for color specifically, most studies tend to base their criteria on those of Berlin & Kay (1969). This study is generally seen as the one that started the debate of whether colors truly are universal to us humans, independent of the environment we live in. They present these criteria at the beginning of their study to establish what *basic* and *basicness* means in relation to color:

1) It must be monolexemic. *Salmon-colored* or *the color of my old rusty bike* would for example not be considered a basic color term because of this.
2) Its signification is not included in any other color term. This criterion is more diffuse, but the authors reference *crimson* and *scarlet* as examples of terms that are disqualified here since they are shades of *red*. How one determines why *crimson* is a type of *red* and not the other way around is ambiguous, but most likely because *red* is more salient among speakers than *crimson*.
3) Its usage cannot be restricted to a narrow class of objects. Words like *blond* and *rusty* are therefore excluded since they are only used for hair or metallic objects.
4) It must be psychologically salient to informants, i.e. it must be used by most of the speakers of a language. This criterion also sounds difficult to interpret initially, but this is often tested through a free elicitation task. Basic color terms are usually the ones mentioned first by participants during an elicited list of colors.

Berlin & Kay (1969) do list a few more criteria that are used only for certain vague color terms[1], but claim that the four listed above are enough in most cases. Berlin & Kay (1969) do not state that color terms that share a name with a real-world referent cannot be a basic color term, but they do claim that color terms that have a real-world referent will typically be restricted in their range by that connection (Berlin & Kay, 1969). While most researchers of color terms generally use these criteria as a basis in their studies, there has been a lot of debate about how well they describe what a basic color term is which we will return to in section 2.2 while discussing the Berlin & Kay (1969) study and the reception it received in more detail.

Many other researchers have attempted to define basicness in relation to color. For example, in Conklin's (1973) review of Berlin & Kay's 1969 study, he writes that the "highest-level, most commonly used, superordinate color categories [...] *basic color terms* are assumed ideally to be non-overlapping, coordinately contrastive, and exhaustive" (Conklin, 1973, p. 936). Other non-basic terms will therefore be included in these larger categories and preferably be either synonyms of these terms or hyponyms. Conklin (1973) uses *vermillion* and *scarlet* as examples of hyponyms of *red* (Conklin, 1973). Mylonas & MacDonald (2016) also provide their own modified version of criteria for what a basic color term should be that they used in their own study of such terms.

For a color term to classify as basic it should:

a. Be widely used in a population of speakers.
b. Have a shared meaning for the associated color stimulus.
c. Be salient in the sense that the color is easily identifiable in an array.
d. Be reliably distinguishable from its neighbors in color space.

(Mylonas & MacDonald, 2016).

Mylonas & MacDonald (2016) focus their criteria much more on the usage of the term itself rather than its appearance. In other words, the criteria limit the terms to ones that are commonly used and

[1]Additional subsidiary criteria to use in doubtful cases:
5) The doubtful form should have the same distributional potential as the previously established basic terms.
6) Color terms that are also the name of an object characteristically having that color are suspect.
7) Recent foreign loan words may be suspect.
8) In cases where lexemic status is difficult to assess, morphological complexity is given some weight as a secondary criterion.

distinguishable but say nothing about the term needing to be monolexemic, non-borrowed, or not being derived from a real-world object (Mylonas & MacDonald, 2016).

2.2 The Field of Color Terminology

The study of color categorization can be dated as far back as the time of Aristotle and Theophrastus in *De Coloribus* (Conklin, 1973). The notion of a potential finite amount of set color categories has also been argued to be "determined for us by Nature" as early as the 19th century (Gladstone, 1858, p. 459). One of the earlier studies interested in comparing color terms between languages was published in 1954 by Brown and Lenneberg. They conducted a color naming study that supports the linguistic relativity principle, that is, that the linguistic categories of a language will affect the cognitive classifications of the speakers and by proxy, the way they think and behave. This is also known as the Saphir-Whorf hypothesis and is often used as a basis for relativism (Brown & Lenneberg, 1954).

2.2.1 Berlin & Kay (1969)

The study that opposed the most generally held opinion of relativism and instead pioneered the idea that colors might be universal was *Basic Color Terms: Their Universality and Evolution* by Brent Berlin and Paul Kay, published in 1969. The main purpose of this project was to determine once and for all whether the camp of relativism was correct in that no universals exist in language, color included. Major researchers within this field (i.e. Edward Sapir and B.L. Whorf) had frequently claimed total semantic arbitrariness in the lexical coding of colors but Berlin & Kay (1969) suspected that this was an overstatement.

While Berlin & Kay (1969) were the authors of the book this study was published in and the ones primarily responsible for the project, the data itself was collected in a collaborative manner by the authors and a group of their students. Only 20 out of the 98 languages investigated were subject to a field study, with the rest originating from other writings, such as dictionaries or other researcher's reports from their field work. To research potential color universals, they used a procedure which included three different tasks. For the entire experiment the stimulus they used was the Munsell Color Chart, shown in figure 1.

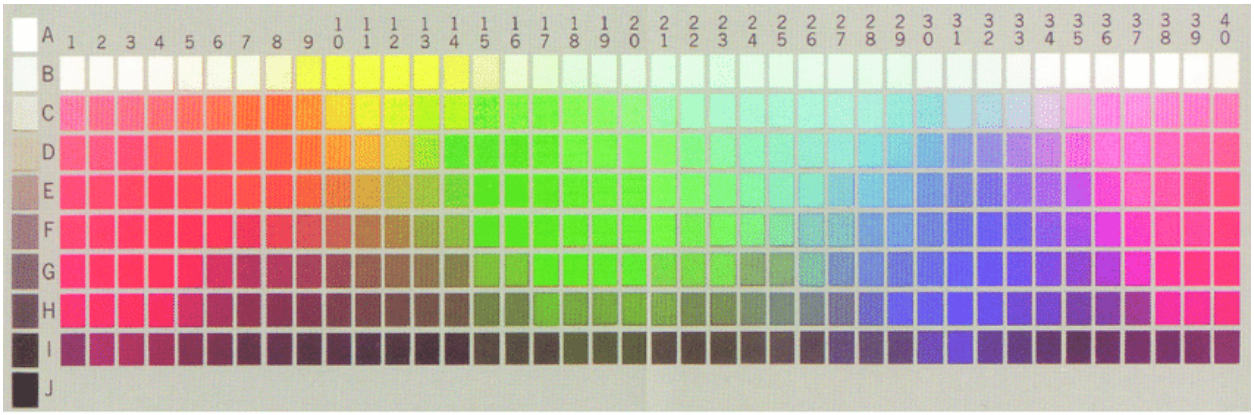

Figure 1: The Munsell Color Chart used by Berlin & Kay (1969). This chart was included in the 1999 paperback edition of *Basic Color Terms: Their Universality and Evolution.*

The first task of the data collection was a free elicitation task where the goal was for the participant to list all the color terms they use in their language. While the authors state that this was done using another language as little as possible, the actual strategy to elicit these terms is not described at any length. In the second task the participants were asked to select one color chip from the Munsell Chart for each color term. This chip should be the *focal*, i.e. the prototypical example for that color. Lastly, the participants were asked to map all the boundaries between the color terms, i.e. group all the color chips that, in their opinion, use the same color term. For this task the informant was given a marker and asked to mark all colors they would under any condition call the current color term being investigated. This was done on three separate occasions at one-week intervals. This task was somewhat problematic since the results were unreliable even within the same individual. Many informants mapped the boundaries differently across the three occasions and the researchers received the feedback that this was a difficult task compared to the other two (Berlin & Kay, 1969).

The participants in this project appear to have been one informant per language except for Tzeltal where 40 speakers participated. The participants were all native speakers of the target language and, with the exception of the Tzeltal speakers, lived in San Francisco. The full list of languages this procedure was carried out on included: Arabic (Lebanon), Bulgarian, Catalan, Cantonese, Mandarin, English, Hebrew, Hungarian, Ibibio, Indonesian, Japanese, Korean, Pomo, Spanish, Swahili, Tagalog, Thai, Tzeltal, Urdu, and Vietnamese (Berlin & Kay, 1969).

Berlin & Kay (1969) present two main findings of the project, the first of which confirmed their hypothesis: color terms are semantically universal. While languages use a different number of terms, all of them use ones from a group of 11 basic color terms: *white, black, red, green, yellow, blue, brown, orange, pink, purple,* and *gray*. The first 6 of these are further categorized as 'primary basic' with the remaining 5 being labeled as 'derived' or 'secondary basic'. While the authors initially claimed that these were the exact and only basic color terms of the world, they later revised this to there being a possibility of more than 11 basic colors existing. Berlin & Kay (1969) also claim that the prototype of each basic color term is similar across languages. The prototypes from each language tend to form so called *clusters* around a specific area of the color space. In addition to this, there appears to be a pattern in the order color terms appear in a language. All languages must include at the very least the terms for *white* and *black* (or something equivalent such as *light* and *dark*) and the order in which the other color terms evolve is always:

(white + black) -> red -> (green + yellow) -> blue -> brown -> (purple + pink + orange + gray)

Based on this finding, the authors claim that all languages can be categorized into seven stages of color term evolution.

- Stage 1: The languages in this category have the least amount of color terms possible in a language, that is, *white/light* and *black/dark*. (Example: Jalé, spoken in New Guinea).
- Stage 2: At this stage *red* is introduced which covers all reds and oranges and most yellows, browns, pinks, and purples. (Example: Tiv, spoken in Nigeria).
- Stage 3: Here languages may be subject to some differences. In some languages *green* is introduced and in others *yellow* is the next color term. If it is *green* this color covers *greens, blue-green, yellow-green, blues,* and *blue-purples* in some cases and in other cases only *greens, yellow-greens* and *light browns*. If *yellow* is added it covers *light green* and *light brown*. (Example: Ibibio, spoken in Nigeria).
- Stage 4: Here the color that was not added in stage 3 out of *green* and *yellow* is added. (Example: Tzeltal, spoken in Mexico).
- Stage 5: At this point *blue* emerges and causes *green* to recede into only *green*. (Example: Plains Tamil, spoken in India).

- Stage 6: Here the last single color is introduced: *brown*. (Example: Nez Perce, spoken in America).
- Stage 7: At this stage the last color terms *orange, pink, gray*, and *purple* are introduced quite rapidly and in no particular order. (Example: Urdu, Cantonese, Catalan, Vietnamese, English etc.)

There are languages that do not fit into this last stage, like Bulgarian that appears to have two basic terms for red and Russian that has two terms for blue.

(Berlin & Kay, 1969).

There is evidence to suggest that the number of color terms in a language is directly related to the size of the vocabulary (Conklin, 1973) and some researchers also claim that there is a correlation between technological development and color terms (Sivik & Taft, 1997)[2]. As for why the colors appear in this specific order, Berlin & Kay (1969) do not have any clear findings to support any explanations but briefly mention a possible connection between the order children learn colors (Berlin & Kay, 1969).

2.2.2 Responses to Berlin & Kay (1969)

The publication of *Basic Color Terms: Their Universality and Evolution* in 1969 caused several scholars to provide insights from their own work on color terms in different languages (McNeil, 1972; Merrifeld, 1971; Snow, 1971). Many also published corroborative evidence in support of the hypotheses of Berlin & Kay (1969) (Hays et al., 1972; Zollinger, 1972). Many agreed that the findings were interesting and probable, but the method used received a lot of critical attention. As Hickerson (1971) states, getting a step-by-step description of their method is not a straightforward matter while reading the study. The fact is that out of all the languages, only the data from Tzeltal was collected through a proper field study. The other 19 were collected from bilinguals residing in San Francisco who attended a seminar held by the authors. It is unclear from the paper how many informants were used for each language, but the authors state that often it was only a singular one for a language. The description of how they elicited the color terms from each of the participants is also vague. Additionally, Hickerson (1971) criticizes the selection of languages used in the study. It is a quite biased sample and for a study wanting to claim something universal across

[2] Though note that some studies suggest the opposite: Wnuk et al., 2022.

all the world's languages, the sample is not varied enough to represent speakers across all language families. Using, presumably, only one speaker for each language, a speaker who is also a bilingual and not a resident of the country the language originates from, may also cause issues for the validity of the results (Hickerson, 1971). While Berlin & Kay (1969) claim that bilingualism should not cause any influence on the color categorization of the participants, other studies have found that there are differences in monolinguals' and bilinguals' use of color terms (i.e. Ervin, 1961).

The criteria provided for determining what colors constitute as basic color terms also have some problems that make it difficult to apply in many cases, especially the additional criteria that exclude borrowings and terms that are also non-color items. Because of these criteria, *orange* should technically not be a basic color term in English (Conklin, 1973), but that contradicts Berlin & Kay's (1969) own findings. The question is whether this specific criterion is still suitable for use today. Because our world is becoming increasingly global, borrowing between languages has become more and more common, including color terms. As the example from Conklin (1973) shows, *orange* should technically not be considered a basic term since it was originally borrowed, presumably from Arabic, and it is also the name of a citrus fruit.

While Berlin & Kay (1969) originally claimed there are only 11 basic color terms, they have since revised this. Most languages only have 11 basic color terms, but the fact is that the number of possible combinations of color terms is not currently logically exhausted with only 11 color terms. Kay & McDaniel (1978) highlight that since there are 6 primary basic color terms (*white, black, yellow, red, blue,* and *green*), there are 15 logically possible pairs of primaries. Red-green and blue-yellow are antagonistic pairs so they can be excluded, but out of the remaining 13 pairs there exist only 5 in the basic color term category (black-yellow: brown, yellow-red: orange, white-red: pink, red-blue: purple, and white-black: gray). 13 potential pairs in addition to the 6 primary color terms there should logically exist 19 basic color terms rather than the 11 originally suggested by Berlin & Kay (1969) (Kay & McDaniel, 1978). The amount of basic color terms is not only few in relation to the ones in common use but also in relation to the color space they fill. The space in the color solid that the 11 color terms fill is very uneven, principally focused in the red-blue and red-yellow area while the blue-green and green-yellow area is named with only 3 terms. Sivik & Taft (1997) set out to see if any more pairs could be found to be used by speakers of English,

Swedish, Polish, or Spanish in their secondary color terms. They found the terms *beige* for white-yellow, *aqua* or *turquoise* for blue-green, *maroon* for red-black*, navy* for blue-black*, sky blue* for white-blue, *chartreuse* or *lime* for green-yellow and potentially *olive(green)* for black-green. To properly fill the entire color space with terms, Sivik & Taft (1997) call for additional studies to be conducted in more technologically advanced societies since they believe there is a greater chance of finding more extensive color language in such societies (Sivik & Taft, 1997).

There are studies that have reported the use of *more* than 11 basic color terms in several languages. For example, Russian has two terms for blue, both of which are in fact basic since they are not interchangeable, as evidenced by Winawer et al. (2007) in their study on Russian and English speakers. Peruvian (Bolton, 1978), Guatemalan Spanish (Harkness, 1973), and Nepali (Bolton et al., 1980) have all been reported to have two terms for blue and French may have two terms for brown (Forbes, 1979). In addition to this discussion of languages with 2 terms for a singular color in English, many studies have also claimed that many color terms that were not included in Berlin & Kay's (1969) 11 terms should be considered basic as well. For example, there has been much discussion if the German *turquoise* should in fact be considered basic (Zimmer, 1982; Zollinger, 1984). In English, there are many color terms that according to Berlin & Kay's (1969) criteria for basicness should be considered 'non-basic' but are being used at the same frequency as basic terms, for example *turquoise, lilac,* and *beige* (Rich, 1977; Boynton & Olson, 1990; Simpson & Tarrant, 1991; Mylonas & MacDonald, 2016). Boynton & Olson (1987) suggested that *peach* should be introduced as an additional basic color term to fill the space between *white, yellow, orange, pink* and *brown*. Sturges & Whitfield (1995) suggested *cream* as the twelfth term since it was used as frequently as the basic color terms but with a clear distinction in their study. *Turquoise* and *lilac* also ranked high in frequency among their participants. Davies et al. (1991) suggested *turquoise* as an additional color term and found *mauve* and *lilac* to be frequently used terms. Lindsey & Brown (2014) suggested *teal, peach, lavender* and *maroon* as candidates for new basic color terms in their study on the current state of the American English color lexicon. *Beige* is a color that has been discussed at great lengths since it often appears in free elicitation tasks and could potentially be upgraded to a basic color term because of this salience. Some have suggested that perhaps a reason it has not already been upgraded is because the color array most often used in studies does not represent the white-yellow space well enough (Sivik & Taft, 1997).

Another aspect that has been studied is whether languages at the same stage of Berlin & Kay's (1969) color evolution will semantically represent color in the same way. Roberson et. al's (2005) research aligns much more with the relativist view of color since they question the evolution of color terms presented by Berlin & Kay (1969). They state that if there is such an evolution of colors, two languages at the same stage of color evolution should have similar cognitive representations of color despite their differences in environment. Roberson et al. (2005) set out to compare Himba speakers to Berinmo speakers, two languages currently at stage 5 of color evolution. In addition to this, they compared them to English speakers, a language at the final stage, seven. The participants were given several tasks, one of which was a memory task where they were shown a color chip and after a delay, asked to point to the chip they had just seen. The authors found that Himba speakers had a considerably higher score when asked to remember colors that were focal in their language rather than the colors that were focal in English or Berinmo. They found that despite the similarity between basic color categories in Himba and Berinmo, Himba speakers showed categorical perception only for their own linguistic categories and not for the supposed universal categories of English or the similar Berinmo (Roberson, et. al, 2005). Recently, a follow-up study was conducted on Himba by Mylonas et al. (2022). They found that while Himba was a 5-color term language in 2005, it has now developed into a 7-color term language, or as the authors prefer to reference it as: 7 categories that are independent of other color terms. Himba used to be a language with the color "grue", the term used by researchers for languages where *blue* and *green* are encoded as one color. As of 2022, Himba now differentiates between these colors and an equivalent of *brown* has also emerged in the terminology, bringing their basic color vocabulary up to 7 (Mylonas et al., 2022).

In addition to these studies building on Berlin & Kay's (1969) work, there are a few that seem to disprove the existence of basic color terms entirely. Umpila is a language that differs substantially in their color naming strategies from many others. Clair Hill conducted a field study published in 2011 on Umpila which shows that while it does technically fall into Stage 2 with three basic color terms (*black, white,* and *red*), they do *not* fill the entire color spectrum with these terms. Berlin & Kay (1969) found that even though languages use a different number of terms, they all fill the color space with these terms, but Hill (2011) found that when she asked Umpila speakers to name the chips of the Munsell Chart, several chips were left without a reply or simply called 'nothing'.

When the participants were asked to sort the chips into categories, many chips were left unsorted, and some were sorted into a sort of 'sub-category' that was labeled for example 'like-red' (Hill, 2011).

Another problematic language for Berlin & Kay's (1969) view on basicness and color naming is Yeli Dnye, studied by Stephen Levinson and published in 2000. He reported that Yeli Dnye does not have any basic color terms at all, at least based on the criteria listed by Berlin & Kay (1969). Yeli Dnye speakers do use color terms to refer to different objects, but all of them are created using conventionalized source-based reduplication. All color terms include the name of either an animal or a plant with the color the speaker is referring to and is therefore not a basic color term (Levinson, 2000). Levinsson's work also highlights many of the issues with claiming that *all* languages can fill the entire Munsell Chart and the notion that color terms must also be basic. Because of the specific criteria on what a basic color term is, both Umpila and Yeli Dnye are unable to be included in the semantic universality with their color terms.

Given the findings of the studies discussed in this background, there is evidence to suggest that a mixture of universalist and relativist views could be adopted for studies in color terms. There appears to be certain semantic universals present in the domain of color, but space should be left for some cross-linguistic variation. The state of the field currently also suggests that there could be more than 11 basic color terms across the languages of the world and the group of secondary terms could contain some promising candidates for new basic color terms.

2.3 Studies on English color terms

In the initial 1969 study, Berlin & Kay (1969) found that English is a stage 7 language with 11 basic color terms. Since then, there have been many studies on English color terms. Smith et al. (1995) proposed that while many studies had been conducted both on basic color terms and secondary terms in English, few studies had attempted to combine the two and draw conclusions about the domain of color as a whole. The authors asked 353 English speakers to write down all the color words they could think of in 2 minutes. These lists included on average 19 terms with 487 different terms being listed across all participants. The 487 terms were then sorted into different categories based on their characteristics. First, any term only listed by one participant

was labeled *novel* while the rest were sorted as *conventionalized*. Next, the conventionalized terms were listed into *simplex* or *complex*, referring to their morphology. Out of the remaining 91 terms, 11 of them were sorted into the *basic* category based on Berlin & Kay's (1969) criteria while the rest were classified as *secondary*. Lastly, both categories were further divided into *opaque* and *transparent*, referring to the meaning of the term. For example, in the basic category only *orange* is considered a transparent term because it is less abstract in its reference than the opaque terms. Smith et al. also found that the 11 basic color terms were more salient than the rest, i.e. they were listed more frequently at the top of the participants lists than the secondary terms (Smith et al., 1995).

Mylonas & MacDonald (2016) conducted a study primarily focused on what *basicness* truly constitutes when concerned with English colors. The authors were interested in finding whether the category of 11 basic colors in English proposed by Berlin & Kay (1969) should be extended to include more terms. They used an experiment conducted online to collect data from a wide range of English speakers. The participants were asked to freely list as many color terms as possible and the experiment ended with 1166 unique color terms. The authors then ranked these according to how frequently they appeared in the participants lists and found that *purple, pink, blue, green,* and *yellow* were the top 5 colors. Mylonas and MacDonald (2016) also found that some non-basic terms were used more frequently than some of the basic ones. For example, *turquoise, lilac, violet,* among others appeared before both *red, orange, black, gray*, and *white*. They eventually concluded that the basic color term category could be extended to 13 instead of 11 by adding *lilac* and *turquoise*. According to Mylonas & MacDonald (2016), including more basic color terms could improve the precision of color naming algorithms, something they test in their study. They conclude that the performance of the model using 13 color terms was superior to the one using only the original 11 basic color terms. They also state that they are not claiming 13 to be the final and definitive number of basic color terms in English, but rather that color terms is a domain that is always undergoing change (Mylonas & MacDonald, 2016).

Another study focused on English and its color terminology was conducted by Lindsey & Brown in 2014. Their aim was to compare their own data of English to the data found in The World Color Survey (WCS). The WCS was a project conducted by Kay et al. (2009) with the goal of collecting

information about the color terminology in otherwise undocumented languages, so comparing that data to English provides a stark contrast between different languages of different societies. The stimulus Lindsey & Brown (2014) used was the Munsell Chart that was also used for the data collection in the WCS. The experiment consisted of two phases, the first of which was a free naming task and the second a constrained naming task. In the first task, the participants were shown each of the 330 chips in the Munsell Color Chart and asked to semi-freely name the color of the chip. The authors used the following criteria for what types of terms the participants could use:

1. The color name must be a single word. (Phrases like light blue and dark green, and phrases with intrinsic modifiers like yellowish are not acceptable.)

2. The word must be a general color name, applicable to anything of that color. (Blond, for example, is not such a word, as it is used to name the color of hair, furniture, or beer, but not, for example, a car or a potato.)

3. The word must be the one that you would normally use to name the color of something in your everyday life. (We are not looking for a unique name for each color. We are not testing for how many different color names you know or can dream up, or how many subtle distinctions in color you can name. We just want to know how you naturally name the colors, when you can use only a one-word name.)

(Lindsey & Brown, 2014, p. 6).

In the second task, the participants were once again shown the Munsell Color Chart chips but this time they were only allowed to use the 11 basic color terms from Berlin & Kay (1969) to name them. Lindsey & Brown (2014) found that the participants collectively used 122 color terms to label the 330 chips in the Munsell Color Chart in the free naming task. *Peach* and *teal* were the only 2 non-basic color terms that were used by more than half of the participants. While many more terms were used in the free-naming task, none of the participants were unable in any way to name the entire Munsell Color Chart using only the Berlin & Kay (1969) basic color terms (Lindsey & Brown, 2014).

2.4 Studies on Swedish color terms

Despite countless studies conducted on the world's languages to either support or oppose Berlin & Kay's findings from 1969, a language that is still largely unexplored in this regard is Swedish. While it is only an official language in one country, it is still in the top 100 languages based on the number of speakers (Swedish Institute, 2024). Despite this, there is a lack of research on Swedish basic color terms. At the time of this study, Sivik & Taft appear to be some of the few researchers who have studied Swedish color terminology. In 1994 the authors conducted a study on the prototypes of different Swedish colors according to Swedish speakers. Something that sets this study apart from many of the other follow-up studies done on other languages after the Berlin & Kay 1969 study is the stimuli Sivik & Taft used. While the use of the Munsell Chart that Berlin & Kay (1969) employed has been criticized before (e.g. Collier, 1973), Sivik & Taft (1994) chose to utilize an entirely different stimulus, the Natural Color System (NCS) (Sivik & Taft, 1994).

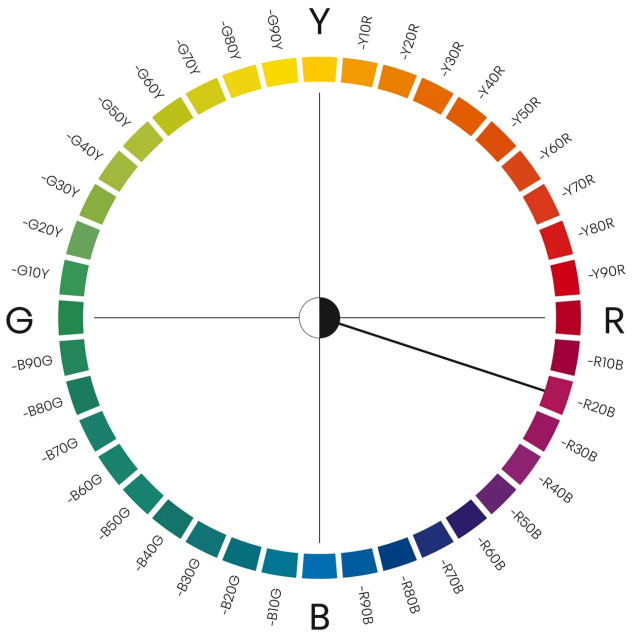

Figure 2: the NCS color system used by Sivik & Taft (1994).

Sivik & Taft (1994) provided participants with different color samples from the NCS along with a color term and asked them to rate how well the color sample corresponded to the term. This was

done with 16 different Swedish color terms: *vit - white, svart - black, gul - yellow, röd - red, blå - blue, grön - green, grå - gray, brun - brown, lila - purple, orange - orange, violett - purple, skär - pink, rosa - pink, olivgrön - olive-green, purpur - purple, beige - beige.* The authors motivate their choice of these terms as wanting to focus primarily on the 6 elementary colors upon which the NCS is based, and the rest of the terms were included in order to have some "common color names" as well (Sivik & Taft, 1994).

In 1997, Sivik & Taft conducted another study on Swedish color terms, this one more focused on the color terminology speakers use. The purpose of the study was to determine if languages spoken in industrialized countries have secondary color terms that are used to the same frequency as basic color terms. After a free elicitation task where the participants were asked to name as many color terms as they could think of, Sivik & Taft (1997) found that participants from all languages listed far more than the 11 basic terms of Berlin & Kay (1969) but also that some non-basic color terms were listed more than some basic color terms. The term *beige* was listed by all the participants while *gray* was not and *beige* was also more commonly listed before *gray*. In addition to this, Swedish appears to have two terms for both *purple* (*violett* and *lila)* and *pink* (*rosa* and *skär)*. Sivik & Taft (1997) calls for more studies to be conducted in technologically advanced societies with more color terms. Since colors like *beige* has the same form in English, Swedish, and Spanish the newer basic color terms and their derivation and place in the color space could tell us more about the processes involved in color category development (Sivik & Taft, 1997).

As can be seen from the section above, there is a prominent gap in the research of Swedish color terminology. In addition to this, there is little research focused on comparing two similar languages that are also spoken in more advanced societies. Roberson et al. (2005) for example compared Himba and Berinmo which are two languages at the same color evolution stage, but they do not have that many color terms. In general, majority of the color terminology research is conducted on less documented languages (e.g. The World Color Survey), which is very valuable, but there is also a lot of information to be gained from comparing technologically advanced languages.

3. Method

The method of this study was largely based on the framework of Berlin & Kay (1969) along with many of the other studies discussed in the background (e.g. Mylonas & MacDonald, 2016; Lindsey & Brown, 2014; Sivik & Taft, 1997). The procedure included five different steps which will be described in detail in section 3.3 along with information about the participants (3.1), materials (3.2), and presentation of data (3.4).

3.1 Participants

The participants for this study were divided into two groups, one group of 15 Swedish monolinguals and one group of 15 English monolinguals, who were all residing in the south of Sweden at the time of the study. Monolingual in this instance refers to a person who has been raised speaking only one language. In other words, the participants may have proficiency in other languages, but not to such a high level or of such frequent use that their native language is no longer their primary language. These restraints have been chosen to balance two important factors to this study:

- The ideal scenario for accurate results would be for the participants to only speak the target language to ensure that no other language proficiency will affect their usage of color.

- Finding participants who are monolingual and with no other language proficiency is next to impossible since Swedish schools begin English education at the latest in third grade (age 9).

The goal was also to create a group of participants of varying ages and genders, since the results are not meant to represent a specific gender or age group but rather the entire population of that language. In table 1 the participants are presented with information about them that is relevant to this study, such as gender, age, native language, and a list of other languages they have proficiency in.

Table 1: Information about the background of the 30 participants in this study.

Participant Code	Gender	Age	Native Language	Other Language(s)
ENG-01	Woman	20	English	French, Russian
ENG-02	Man	24	English	Irish, French, German
ENG-03	Man	24	English	French, Spanish
ENG-04	Woman	19	English	-
ENG-05	Woman	19	English	Danish
ENG-06	Woman	20	English	Slovak
ENG-07	Woman	22	English	Spanish
ENG-08	Man	42	English	French
ENG-09	Woman	54	English	French
ENG-10	Man	34	English	-
ENG-11	Woman	45	English	-
ENG-12	Woman	26	English	Russian
ENG-13	Woman	20	English	French
ENG-14	Man	75	English	French
ENG-15	Woman	78	English	-
SWE-01	Woman	23	Swedish	English, German
SWE-02	Man	56	Swedish	English, German
SWE-03	Woman	54	Swedish	English, Spanish, French
SWE-04	Man	24	Swedish	English
SWE-05	Woman	53	Swedish	English
SWE-06	Man	58	Swedish	English, German
SWE-07	Man	90	Swedish	English, French
SWE-08	Woman	18	Swedish	English, Spanish
SWE-09	Woman	23	Swedish	English, German
SWE-10	Woman	23	Swedish	English, Spanish
SWE-11	Man	57	Swedish	English
SWE-12	Man	23	Swedish	Italian, English, French
SWE-13	Man	76	Swedish	English
SWE-14	Woman	78	Swedish	-
SWE-15	Man	81	Swedish	English

All participants were also tested for color blindness using an online version of the Ishihara test (Colorite) and achieved a minimum score of 10/12 correct answers which means that they have a normal color vision.

3.2 Materials

The materials for this study included a survey (See Appendix A and B) that the participants were asked to complete before beginning the tasks. The survey consisted of questions about the participants' age, gender, occupation, native language, and other languages the participants had any proficiency in along with an indication of how frequently they use the language and at what age they began acquiring it. This question ensured that no bilinguals participated while also providing an approximation of how often a participant used another language and thereby how much that language may affect their results. The questions about age and gender were used to discuss any potential patterns found within these social categories and the participants were not required to list them if they did not wish to. Recording the participants' occupation could help explain any abnormalities caused by a job where one works a lot with color.

The stimulus for the tasks was the Munsell Color Chart which was used by Berlin & Kay (1969), for the World Color Survey and by many other studies on color terms. Other color charts do exist and have been argued for (see 2.4 about the NCS color scale) but the Munsell color chart was chosen as it is still the most frequently used color chart in color studies. The chart consists of 330 colored chips varying in hue and brightness with their saturation as high as possible for the human eye.

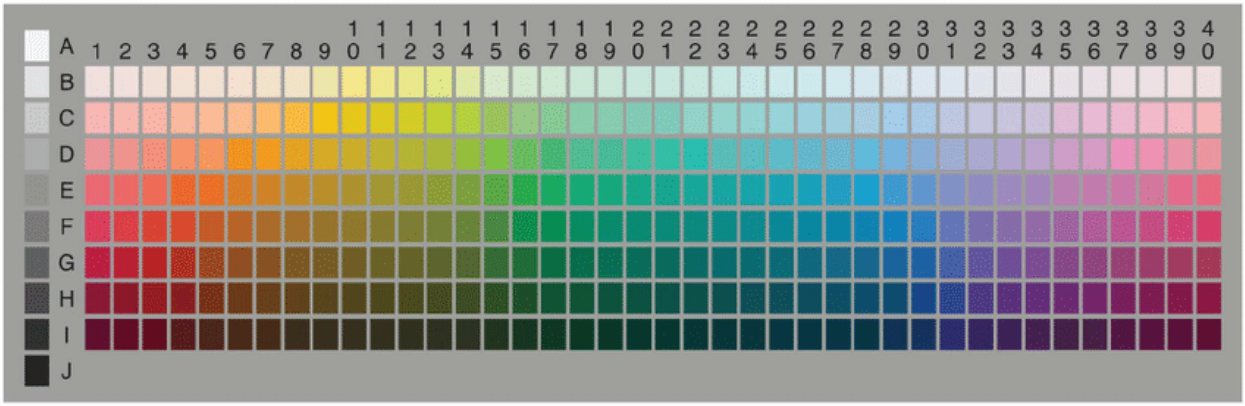

Figure 3: The Munsell Color Chart used as stimulus in the prototype and boundary tasks.

This color chart was shown to the participants on the same computer screen using a Samsung Galaxy Notebook 4 where the brightness was set to maximum brightness (300 Nit). The participant was located in a room with only one lamp using an opal normal light bulb of the brand AIRAM

with an LED light source, technical specifications 9W 2700-6500K RGB E27 806LM. This lamp can imitate daylight, hence its usage in this study. Showing the participants the stimuli on the same computer screen with the same settings also better guarantees that the stimuli appear the same way to the participants than printing the stimuli would.

3.3 Procedure

The procedure for this experiment included five steps and was carried out individually by the participants:

1. The first step was the Color Blindness Test by Ishihara since no participant who did not pass this test could participate. This test consists of colored circles with a number in a different color inside it which the participants are expected to input correctly.

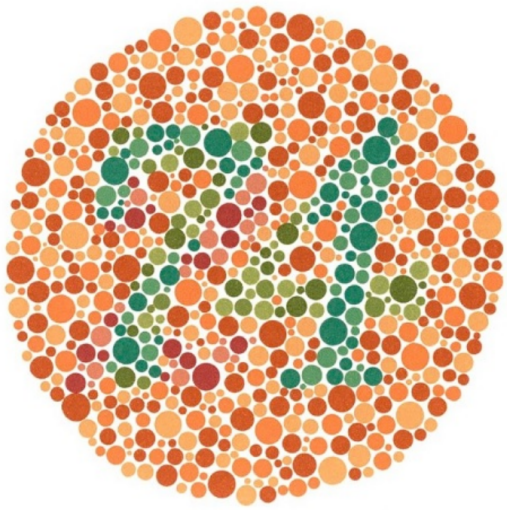

Figure 4: Example of stimulus from the Ishihara Color blindness test.

Inputting 10 out of 12 stimuli correctly was considered a passing grade and indicated a normal color vision. A print screen for each of the participants' results was taken and placed at the end of their participant sheet (See Appendix G).

2. In the second step the participants were asked to fill in the survey that was described in the 3.2 materials section.

3. The third step, and the first task, was a free elicitation task. The participants were asked to write down as many colors as they could think of in the order they think of them. This task was entirely cognitive, there was no color stimuli present during the writing of this list. There was also no time limit, rather the participants were encouraged to take as much time as they would like but advised to finish whenever they were unable to recall any more colors for a prolonged amount of time. They were also given a few restrictions on what terms to write, but these were more presented as guidelines rather than strict criteria. The criteria were based on Lindsey & Brown (2014) but have been adapted for the specific purposes of this study:

a. The color name should not be a phrase including words like light and dark or a phrase with intrinsic modifiers like -ish. Using non-general modifiers is permitted.

b. The word must be a general color name, applicable to anything of that color. (Blond, for example, is not such a word, as it is used to name the color of hair, furniture, or beer, but not, for example, a car or a potato.)

c. The word must be one that you would normally use to name the color of something in your everyday life. (I am not testing how many different color names you know or can dream up, or how many subtle distinctions in color you can name.)[3]

If the participants had any questions about whether to include a term or not, they were encouraged to ask. They were also encouraged to put down terms that I may not need for this study rather than exclude ones I might have needed since I could review their terms before the second task and remove any color terms that were in violation of any of the criteria.

4. The fourth step of the process was the prototype task where the participants were shown the Munsell Color Chart. They were instructed to indicate which chip in the scale they felt best represents each color term they listed in the previous task. Each answer was followed by approximately 3 seconds of a white screen being shown before the color scale returned

[3] The Swedish participants received a translated version of these instructions, see Appendix B.

and they were asked to indicate the chip for the next term. Their answers were recorded by the coordinates of the chip they indicated either through pointing or placing their cursor on it. The participants were also shown how to read the coordinates of the chart so that they could verbally tell me their choice should they wish to.

5. The fifth and final step of the data collection was the boundary task. In this task, the participants were once shown an image of the Munsell Color Chart, but this time with one of the 11 basic color terms listed by Berlin & Kay (1969) labeled at the top of the page. They were asked to, in whatever manner they preferred, indicate with the help of a drawing tool which color chips they would include in that term. Some participants chose to draw lines to indicate the boundaries, and some chose to draw crosses or dots on each chip they wished to include. It was also clarified that the point was for the participants to decide themselves whether, for the example of *red*, they wanted to include only *red* chips or if they wanted to include terms that are red-adjacent such as *scarlet, burgundy* or even *pink*. This was done with a computer mouse in the program Canva where one can use a drawing tool to draw on top of images. Any participant who felt uncomfortable drawing on a computer had the option to guide me in drawing their boundaries through pointing at the screen as they did in the prototype task.

3.4 Data Analysis

The data[4] will be presented in three different sections corresponding to the three tasks the participants performed:

1. The first task, the free elicitation task, will be shown through two tables, one for each language. These tables will include all the color terms the participants listed, how many times these terms were found on a list, their mean ranking, and the number of times this term was put first on a list.
2. The data for the prototype task will be presented in the form of images of the Munsell Color Chart with dots that show all the color terms the participants listed. Note that there is only

[4] Appendix G provides a link to download all the data collected for this thesis.

one dot per chip, the exact number of participants who selected a chip is shown in the note under the image. For the chip that was selected by the most participants for each term, an image of that chip along with its hex code will also be presented. The process described above will be done with colors that were listed by at least half of the participants. The rest of the terms and the chips selected as prototypes for them can be found in Appendix E and F.

3. For the boundary task, each basic color term will be presented with an image of the Munsell color chart with a number indicating how many participants chose to include a chip in each term's boundaries.
4. The last section will show an image of the Munsell chart with all the modal chips for the colors listed by more than half of the participants, one for each language side by side. There will also be an image for each language of the Munsell chart that indicates all of the boundaries between the basic color terms. A line drawn right through a chip indicates that this chip was included by the same number of participants in two different color boundaries.

The data will then be discussed and analyzed primarily based on the similarities and differences between English and Swedish, but some comparisons will also be made between gender and age. This was not an intended perspective of the study, but since some interesting differences were found these will be presented separately in section 5.4 of the discussion. For this section, the categories will be man and woman since none of the participants identified as non-binary, while the age of the participants will be divided into 3 evenly distributed groups, the first including participants aged 18-39, the second group those aged between 40-59, and the third group anybody over the age of 60.

3.5 Ethical Issues

This study does not deal with any sensitive information such as ethnic background, health status, criminal background, etc. It does, however, collect personal information about the participants, such as age, gender, and occupation. Therefore, the participants were asked to sign a form of consent (See Appendix C and D) but were also informed that the information collected from them is completely anonymous. They could also choose not to answer questions about their age, gender,

and occupation should they not want to since this was not critical information for the thesis. The only information they had to supply was their native language.

4. Results

This section will cover the results of the data collection. The results will be presented in the order of free elicitation task, prototype task, and boundary task. English will be presented first for each of these sections, followed by Swedish.

4.1 Results of Free Elicitation Task, English

This section shows the results of the free elicitation task for the English participants. For each term, the frequency shows how many participants included it on their list, the mean ranking refers to the average value of the term's placement on the lists. The last column refers to how many participants listed this term first.

Table 2: List of colors named by the English participants: term, number of occurrences, mean ranking in lists, and number of times term appeared first on the list.

Color term	Frequency	Mean Ranking	Amount of nr 1 occurrences
Red	15	2.6	7
Blue	15	4.4	5
Green	15	4	1
White	15	11.4	1
Purple	15	8	-
Yellow	15	5.8	-
Black	15	9.4	-
Orange	14	7.2	-
Grey	14	11.7	-
Pink	13	8	1
Brown	11	11.6	-
Turquoise	10	11.4	-
Beige	10	15.6	-
Maroon	8	12.2	-
Navy	7	13.5	-
Magenta	6	17	-
Lavender	5	13.8	-
Lilac	5	13.4	-
Cyan	4	16.2	-
Burgundy	4	10	-
Teal	4	8.7	-
Violet	4	13	-
Lime	4	16.2	-
Silver	3	12	-
Gold	3	12.3	-

Cream	3	18.3	-
Periwinkle	3	13	-
Chartreuse	3	11	-
Forest green	3	18	-
Scarlet	3	6.3	-
Peach	2	17.5	-
Mauve	2	11.5	-
Mustard	2	16	-
Indigo	2	9.5	-
Baby pink	2	14	-
Baby blue	2	15	-
Sky blue	2	16.5	-
Charcoal	1	15	-
Bronze	1	16	-
Tan	1	17	-
Blood orange	1	18	-
Sage	1	20	-
Terracotta	1	17	-
Crimson	1	4	-
Apricot	1	6	-
Plum	1	15	-
Fuchsia	1	16	-
Khaki	1	24	-
Cerise	1	15	-
Coral	1	10	-
Vanilla	1	21	-
Kelly green	1	23	
Amber	1	24	-
Emerald green	1	25	-
Chestnut	1	26	-
Cerulean	1	28	-
Midnight blue	1	31	-
Dusty pink	1	33	-
Rose	1	34	-
Aquamarine	1	16	-
Off-white	1	19	-
Salmon	1	20	-
Eggshell	1	21	-

4.2 Results of Free Elicitation Task, Swedish

This section shows the results of the free elicitation task for the Swedish participants. For each term, the frequency shows how many participants included it on their list, the mean ranking refers to the average value of the term's placement on the lists. The last column refers to how many participants listed this term first.

Table 3: List of colors named by the Swedish participants: term, number of occurrences, mean ranking in lists, and number of times term appeared first on the list.

Color term	Frequency	Mean Ranking	Amount of nr 1 occurrences
Blå	15	5.3	3
Grön	15	4.6	3
Gul	15	4.8	1
Röd	15	3.4	4
Rosa	15	9.5	1
Svart	15	7.7	1
Vit	15	8.6	-
Lila	14	10.4	-
Grå	13	11	1
Brun	13	10.8	-
Orange	12	7.9	-
Turkos	8	13.1	-
Violett	7	10.2	-
Beige	6	18.5	-
Vinröd	6	9.3	-
Silver	6	13	-
Marinblå	5	10	-
Guld	5	12.6	-
Cerise	4	10.7	-
Gredelin	4	17.2	-
Magenta	4	8.5	-
Kolsvart	3	16.3	-
Purpur	3	13.6	-
Brons	3	16.6	-
Skogsgrön	3	11.6	-
Plommon	3	22	-
Himmelsblå	3	16.3	-
Brandgul	2	17	-
Azur	2	15	-
Petroleum	2	16	-
Smaragdgrön	2	10	-
Lime	2	11.5	-
Mossgrön	2	17	-
Militärgrön	2	20.5	-

Indigo	2	24.5	-
Aprikos	2	18.5	-
Okra	2	14	-
Lavender/l	2	10	-
Cyan	2	6	-
Koppar	1	14	-
Barrgrön	1	20	-
Blodröd	1	19	-
Havsblå	1	17	-
Snövit	1	16	-
Senapsgul	1	14	-
Krom	1	11	-
Pissgul	1	15	-
Kornblå	1	11	-
Rapsgul	1	26	-
Gammelrosa	1	22	-
Bärnsten	1	21	-
Kastanjebrun	1	17	-
Midnattsblå	1	9	-
Mauve	1	22	-
Korall	1	21	-
Mintgrön	1	10	-
Hudfärg	1	22	-
Vaniljvit	1	20	-
Kritvit	1	19	-
Babyrosa	1	13	-
Babyblå	1	12	-
Citrongul	1	19	-
Scharlakansröd	1	18	-
Kobolt	1	20	-
Antracit	1	17	-
Gråmetallic	1	2	-

4.3 Results of Prototype Task, English

This section shows the results of the prototype task for the English participants. Each color term is presented in order of number of occurrences (See table 2) and is accompanied by an image of the Munsell color chart. The dots on the chart indicate which chips have been selected as the prototype for this term. The actual number of participants who selected the chip can be found in the text under the chart. The coordinates listed refer to the vertical and horizontal position of the chip. Finally, the modal chip, i.e., the chip that the most participants selected is shown separately

along with its hex code. Since the coordinates from the Munsell color chart hold no meaning outside of this specific chart, the hex code, which is a more universal manner of referring to a specific color shade, is also provided.

Red:

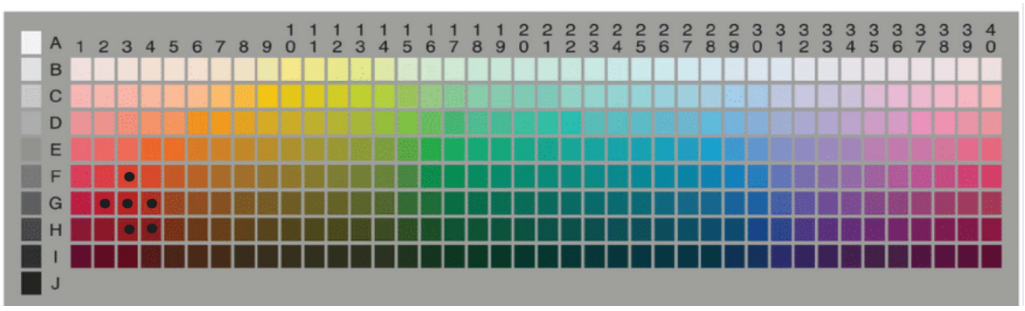

Figure 5: Results of prototype selection for the color term *red*: 1. G3(9) 2. F3(2) 3. G4(1), H3(1), H4(1), and G2(1).

Modal chip: G3 (selected by 9 participants) #b82425

Blue:

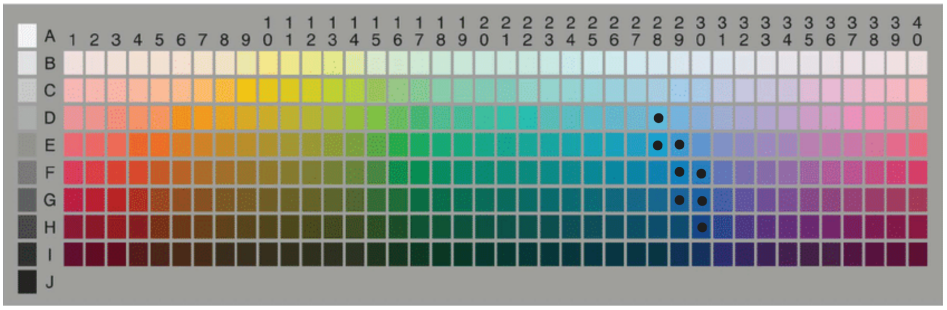

Figure 6: Results of prototype selection for the color term *blue*: 1. F30(3), G30(3) 2. F29(2), G29(2), H30(2) 3. E29(1), E28(1), and D28(1).

Modal chips: F30 and G30 (selected by 3 participants each) #297ebe and #1c62a3

Green:

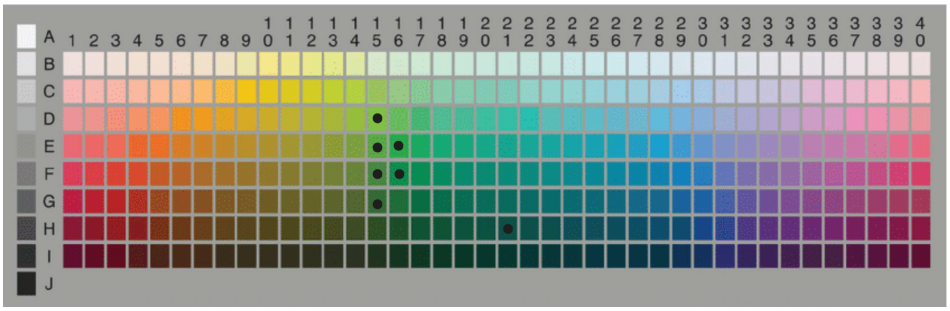

Figure 7: Results of prototype selection for the color term *green*: 1. F16 (8) 2. E16(4) 3. F15(3), D15(3), 4. E15(1), H21(1), and G15(1).

Modal chip: F16 (selected by 8 participants) #169c4f

White:

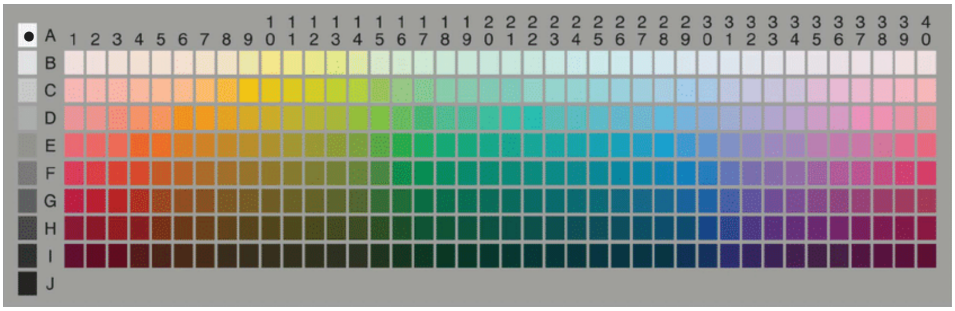

Figure 8: Results of prototype selection for the color term *white.*

Modal chip: A (selected by all 15 participants) #f8f9f9

Purple:

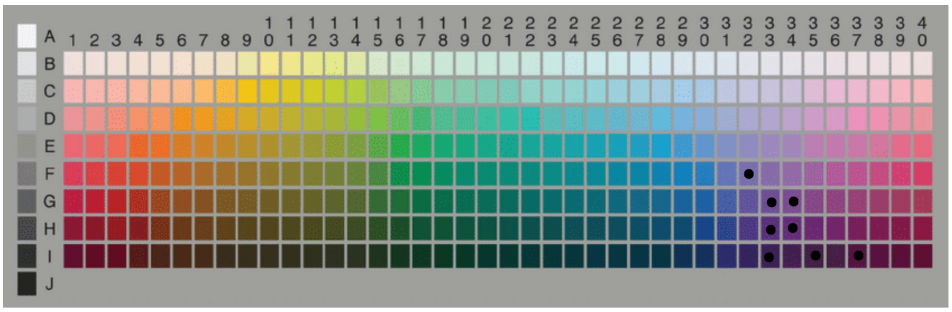

Figure 9: Results of prototype selection for the color term *purple*: 1. G33(4) 2. H34(3) 3. G34(2), H33(2) 4. I35(1), F32(1), I37(1), and I33(1).

Modal chip: G33 (selected by 4 participants) #734e96

Yellow:

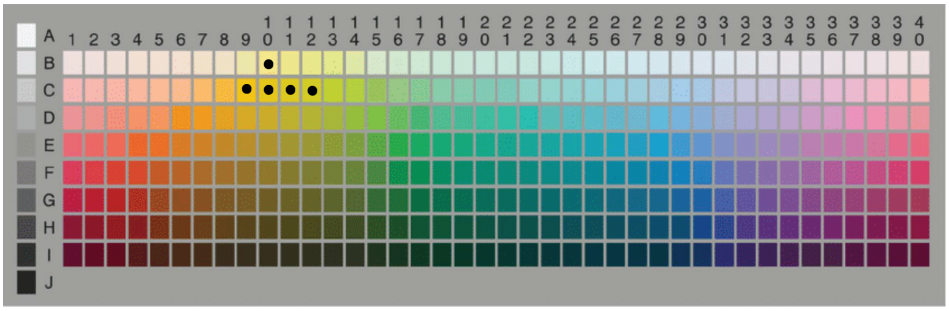

Figure 10: Results of prototype selection for the color term *yellow*: 1. C9 (8) 2. C10(2), C11(2), C12(2) 3. B10(1).

Modal chip: C9 (selected by 8 participants) #f1c415

Black:

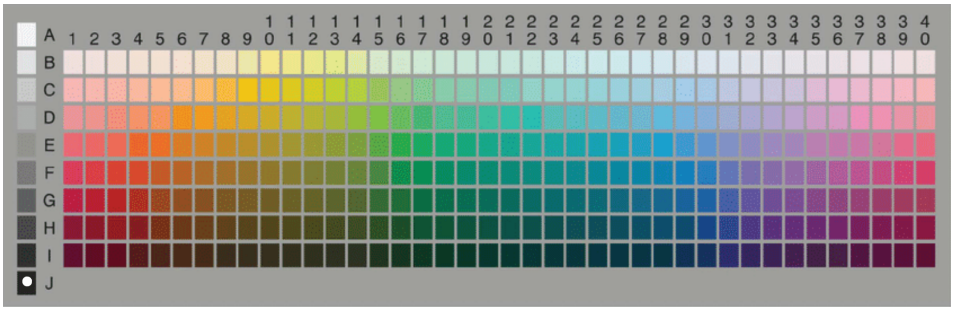

Figure 11: Results of prototype selection for the color term *black.*

Modal chip: J (selected by all 15 participants) #242421

Orange:

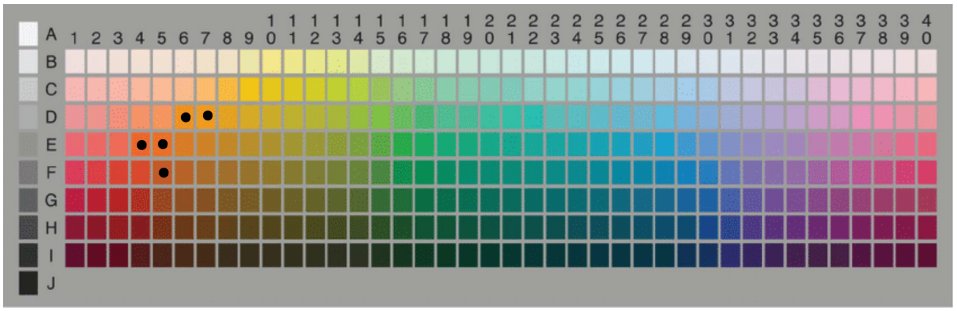

Figure 12: Results of prototype selection for the color term *orange:* 1. E5(5) 2. D6(3), E4(3) 3. D7(2) 4. F5(1).

Modal chip: E5 (selected by 5 participants) #ec7627

Grey:

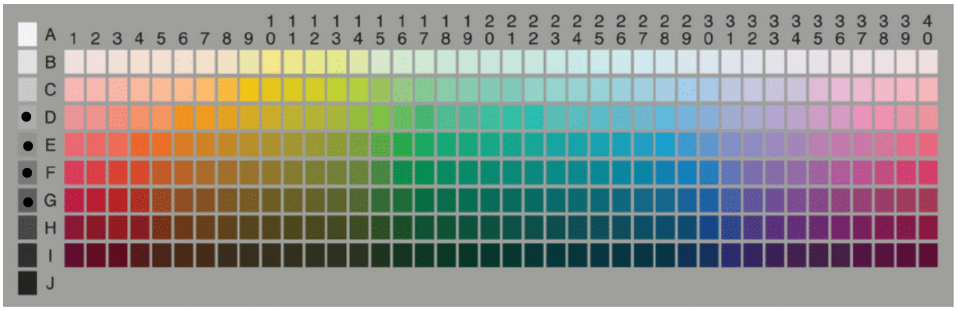

Figure 13: Results of prototype selection for the color term *gray*: 1. D(5) 2. E(4) 3. F(3) 4. G(1).

Modal chip: D (selected by 5 participants) #acafad

Pink:

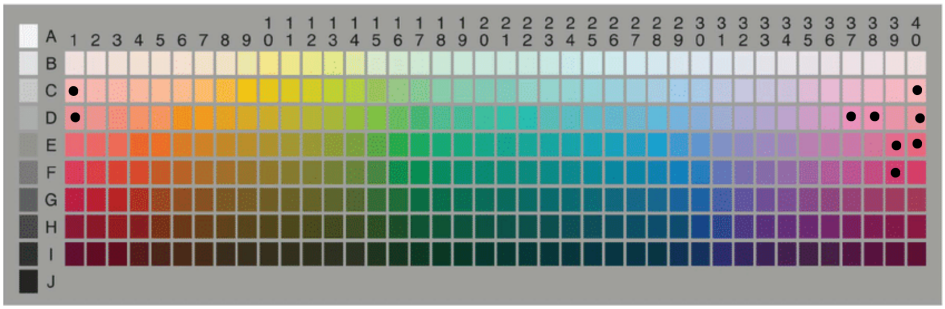

Figure 14: Results of prototype selection for the color term *pink:* 1. E39(4) 2. D38(2) 3. F39(1), D1(1), E40(1), D37(1), C1(1), C40(1), and D40(1).

Modal chip: E39 (selected by 4 participants) #e46b8c

Brown:

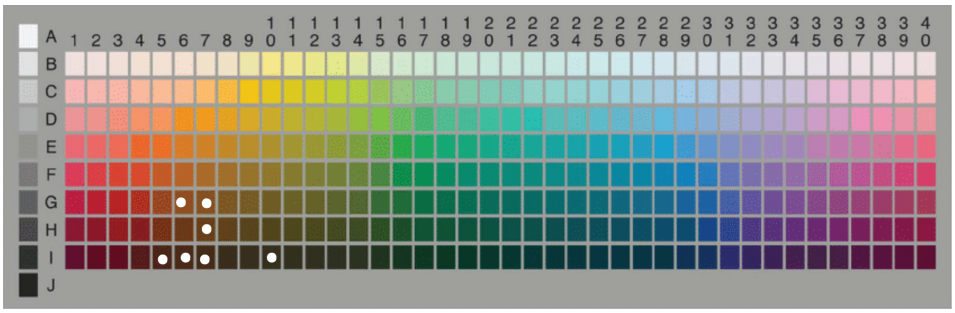

Figure 15: Results of prototype selection for the color term *brown:* 1. H7(3) 2. I7(2), G6(2) 3. I6(1), I10(1), G7(1), and I5(1).

Modal chip: H7 (selected by 3 participants) #67411b

Turquoise:

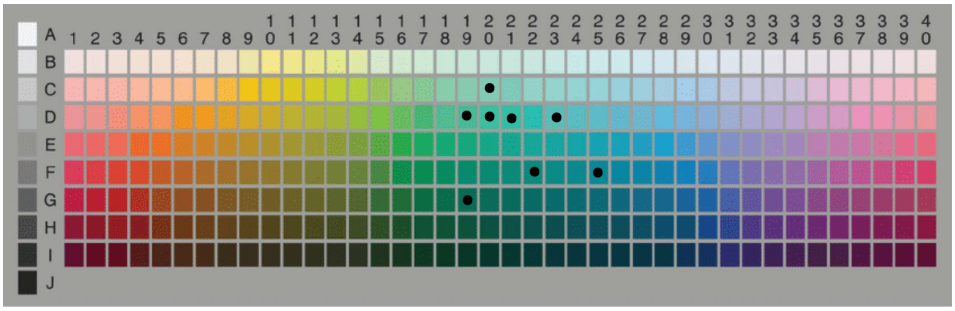

Figure 16: Results of prototype selection for the color term *turquoise:* 1. D21(2), D20(2)2. F22(1), G19(1), C20(1), F25(1), D23(1), and D19(1).

Modal chip: D21 and D20 (selected by 2 participants each) #3bbea0 and #3dbe9e

Beige:

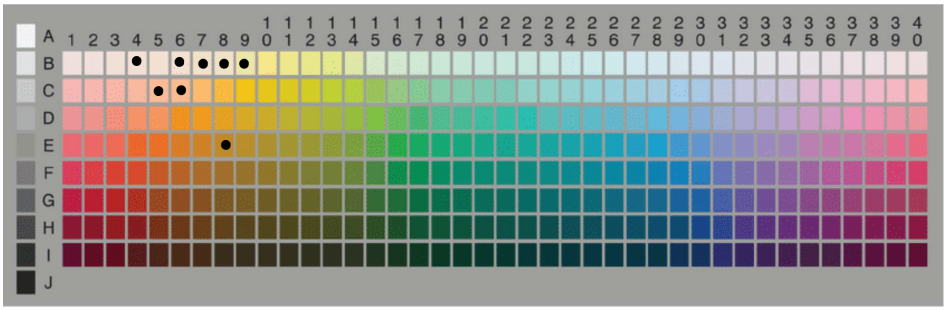

Figure 17: Results of prototype selection for the color term *beige:* 1. B8(2), C5(2) 2. B9(1), B4(1), B7(1), E8(1), B6(1), and C6(1).

Modal chip: B8 and C5 (selected by 2 participants each) #f4e1d1 and #fbbb97

Maroon:

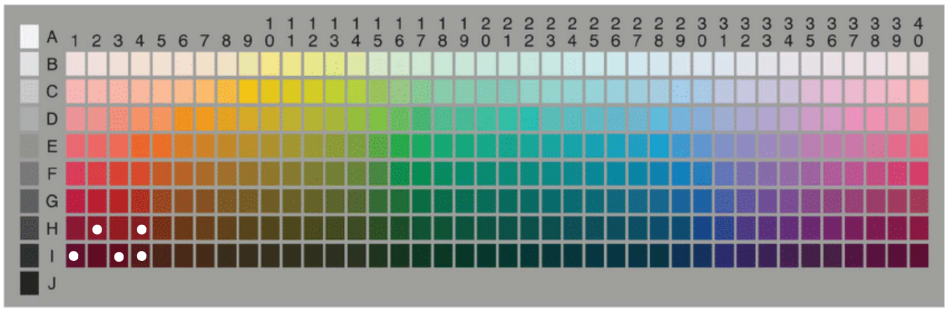

Figure 18: Results of prototype selection for the color term *maroon:* 1. I4(4) 2. H4(1), H2(1), I1(1), and I3(1).

Modal chip: I4 (selected by 4 participants) #57161f

The rest of the colors found in Table 2 were mentioned by less than half of the participants so therefore the chips selected as the prototype for them can be found in Appendix E.

4.4 Results of Prototype Task, Swedish

This section shows the results of the prototype task for the Swedish participants. Each color term is presented in order of number of occurrences (see table 3) and is accompanied by an image of the Munsell color chart. The dots on the chart indicate which chips have been selected as the prototype for this term. The actual number of participants who selected the chip can be found in the text under the chart. The coordinates listed refer to the vertical and horizontal position of the chip. Lastly, the modal chip, i.e., the chip that the most participants selected is shown separately along with its hex code. Since the coordinates from the Munsell color chart hold no meaning outside of this specific chart, the hex code, which is a more universal manner of referring to a specific color shade, is also provided.

Blå:

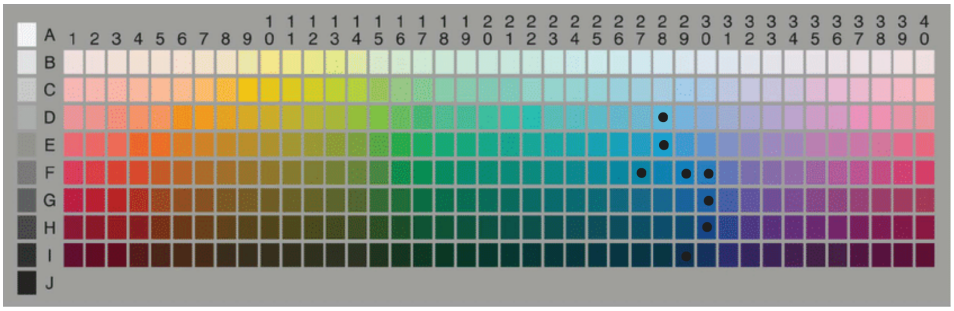

Figure 19: Results of prototype selection for the color term *blå:* 1. F30(5) 2. F27(2), E28(2), F29(2) 3. D28(1), I29(1), H30(1), and G30(1).

Modal chip: F30 (selected by 5 participants) #297ebe

Grön:

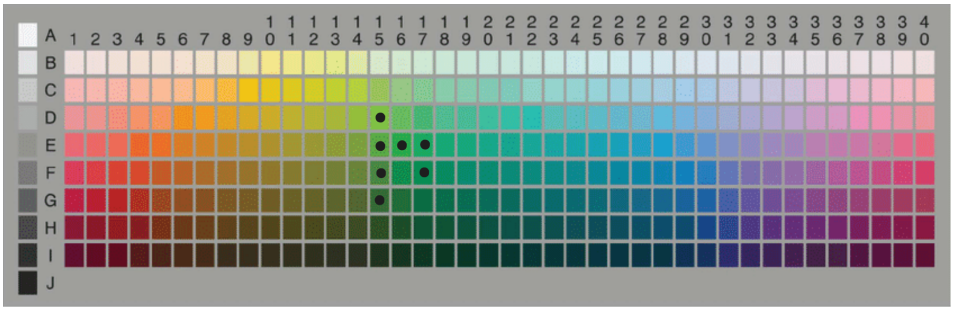

Figure 20: Results of prototype selection for the color term *grön:* 1. E16(3), E15(3), F15(3), D15(3) 2. G15(1), F17(1), and E17(1).

Modal chips: E16, E15, F15, and D15 (selected by 3 participants each) #22a94d, #5bac46, #3e8948, and #7fc144

Gul:

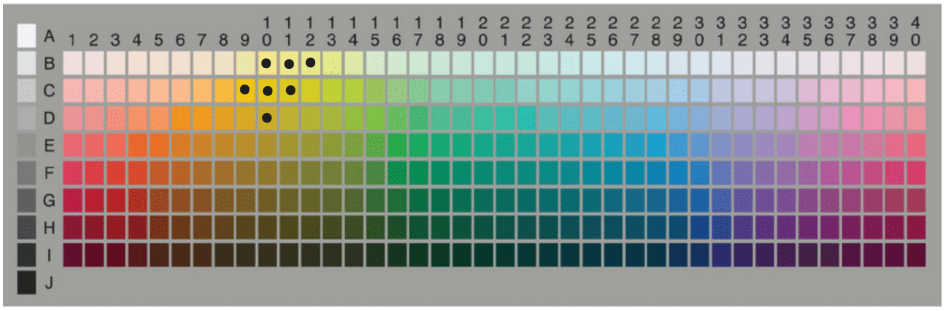

Figure 21: Results of prototype selection for the color term *gul:* 1. C11(5) 2. C9(3) 3. B11(2), C10(2) 4. B12(1), D10(1), and B10(1).

Modal chip: C11 (selected by 5 participants) #d8cc24

Röd:

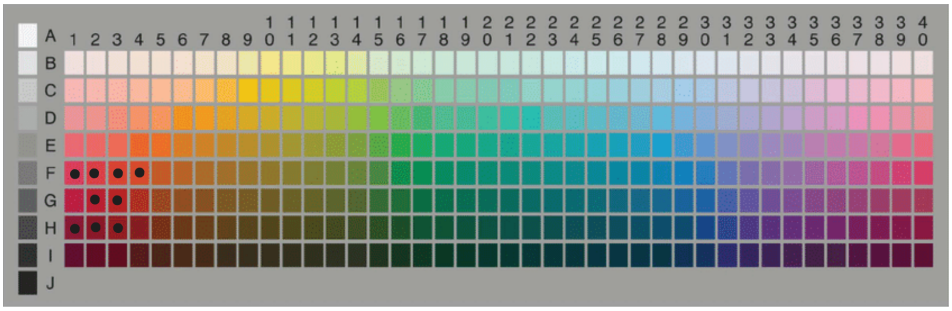

Figure 22: Results of prototype selection for the color term *röd:* 1. G3(4) 2. F3(3) 3. G2(2) 4. H3(1), H2(1), H1(1), F1(1), F2(1), and F4(1).

Modal chip: G3 (selected by 4 participants) #b82425

Rosa:

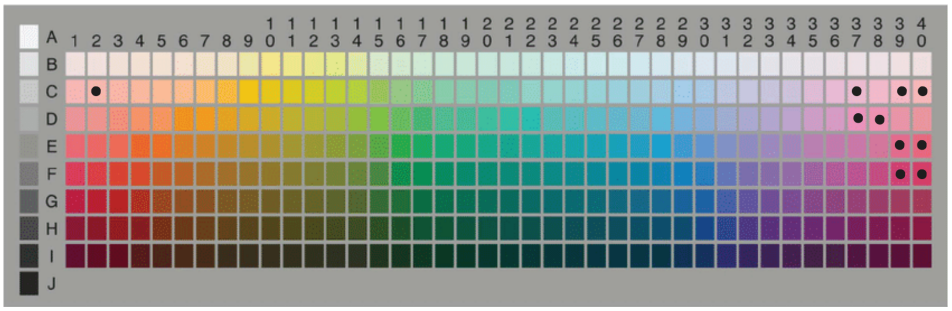

Figure 23: Results of prototype selection for the color term *rosa:* 1. D38(3) 2. E39(2), C39(2), C40(2) 3. F40(1), D37(1), F39(1), C37(1), E40(1), and C2(1).

Modal chip: D38 (selected by 3 participants) #f092b1

Svart:

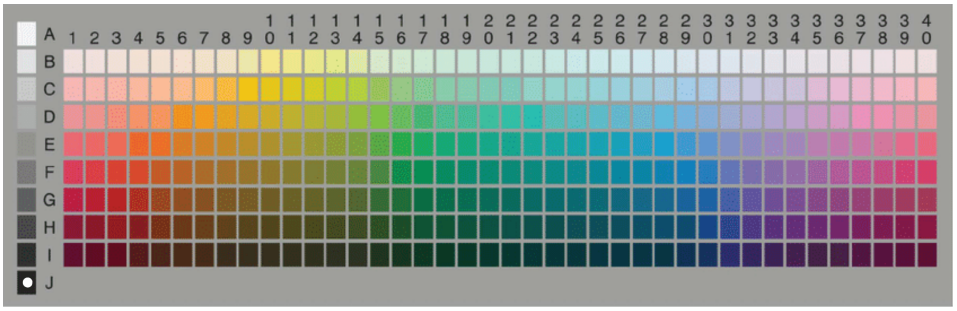

Figure 24: Results of prototype selection for the color term *svart.*

Modal chip: J (selected by all 15 participants) #242421

Vit:

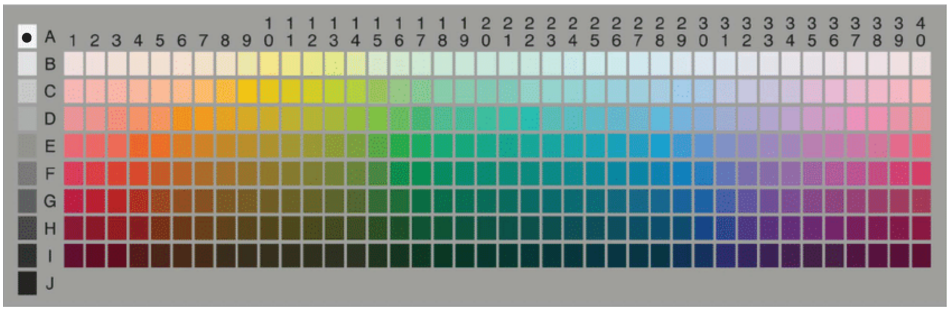

Figure 25: Results of prototype selection for the color term *vit.*

Modal chip: A (selected by all 15 participants) #f8f9f9

Lila:

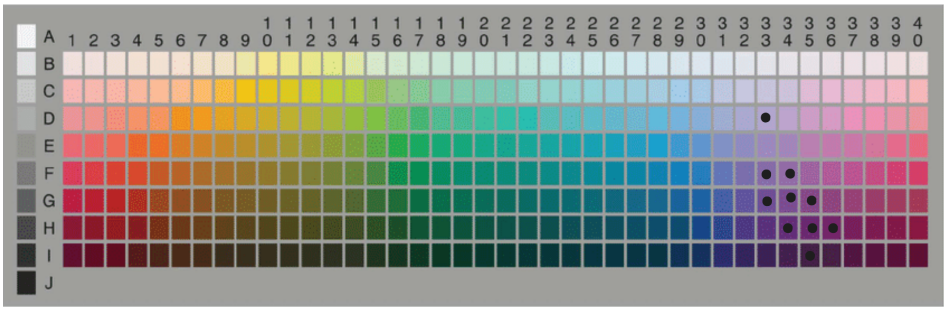

Figure 26: Results of prototype selection for the color term *lila*: 1. G33(3), H34(3) 2. G34(2) 3. I35(1), F34(1), H36(1), D33(1), F33(1), H35(1), and G35(1).

Modal chip: G33 and H34 (selected by 3 participants each) #734e96 and #662c75

Grå:

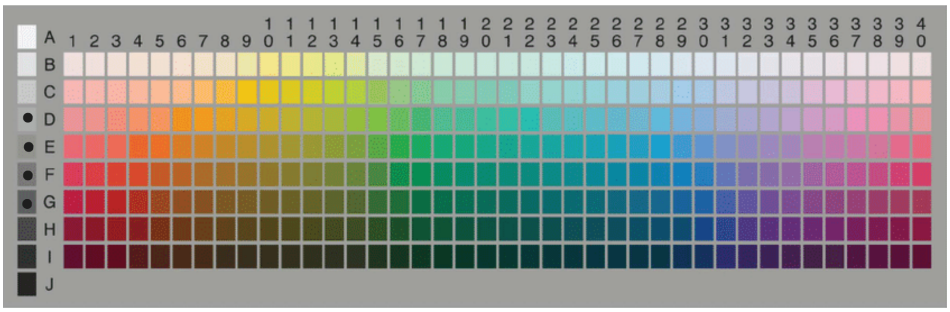

Figure 27: Results of prototype selection for the color term *grå:* 1. E(5) 2. D(3), F(3) 3. G(2).

Modal chip: E (selected by 5 participants) #969294

Orange:

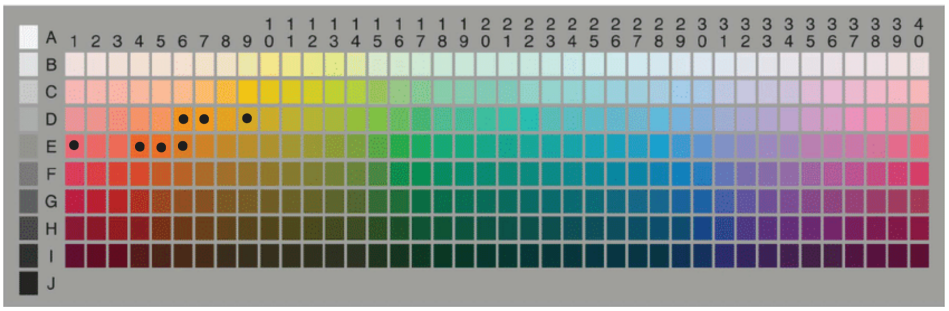

Figure 28: Results of prototype selection for the color term *orange:* 1. D7(4) 2. D6(3) 3. E5(1), E6(1), E4(1), D9(1), and E1(1).

Modal chip: D7 (selected by 4 participants) #f2991f

Brun:

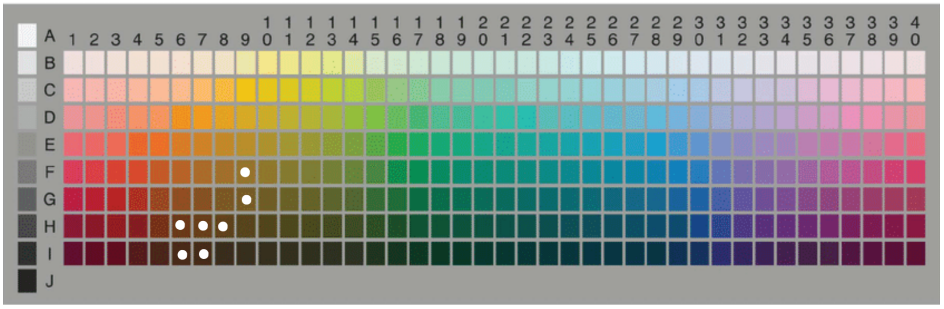

Figure 29: Results of prototype selection for the color term *brun:* 1. I7(4) 2. H6(3) 3. I6(2) 4. H8(1), H7(1), F9(1), and G9(1).

Modal chip: I7 (selected by 4 participants) #482a18

Turkos:

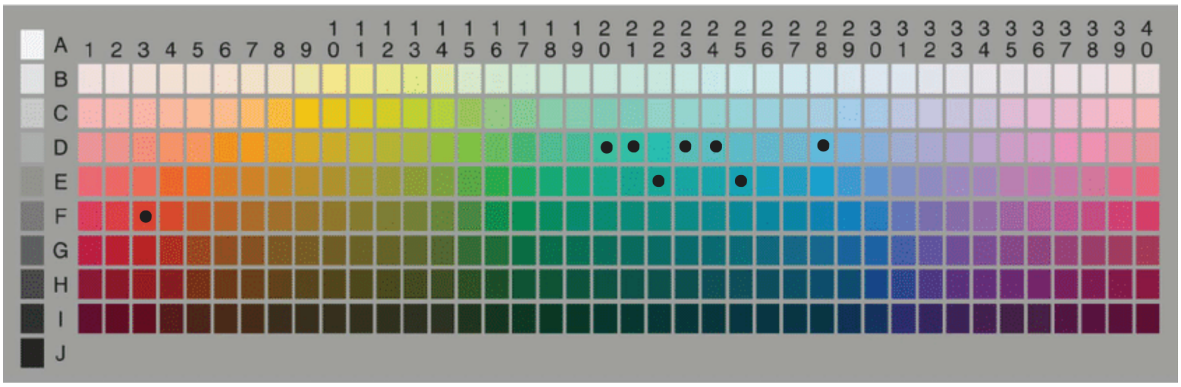

Figure 30: Results of prototype selection for the color term *turkos:* E25(1), D23(1), D28(1), F3(1), D20(1), E22(1), D21(1), and D24(1).

Modal chip: X[5]

The rest of the colors found in Table 3 were mentioned by less than half of the participants so therefore the chips selected as the prototype for them can be found in Appendix F.

4.5 Results of boundary task, English

This section shows the results of the boundary task for the English participants. This task only included the basic color terms, so the terms are presented here in the same order as they were shown to the participants. Each term is accompanied by an image of the Munsell color chart with

[5] Since all participants selected a different chip as the prototype, *turkos* has no modal chip.

numbered chips. The number on a chip indicates how many participants chose to include it in the relevant color term.

Red

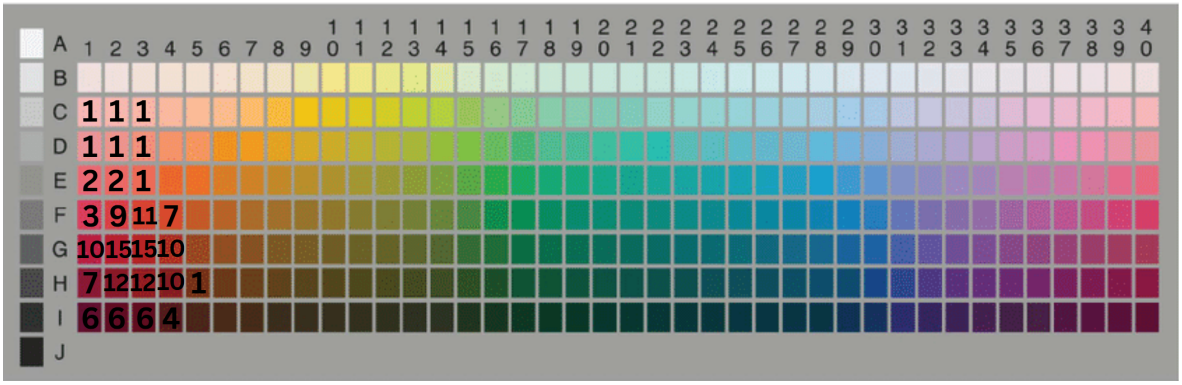

Figure 31: Boundary results for the color term *red.*

Blue

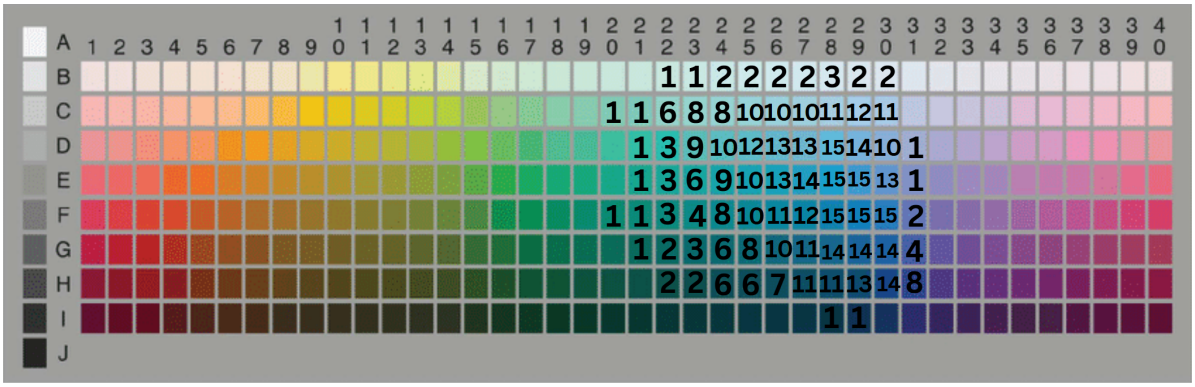

Figure 32: Boundary results for the color term *blue.*

Yellow

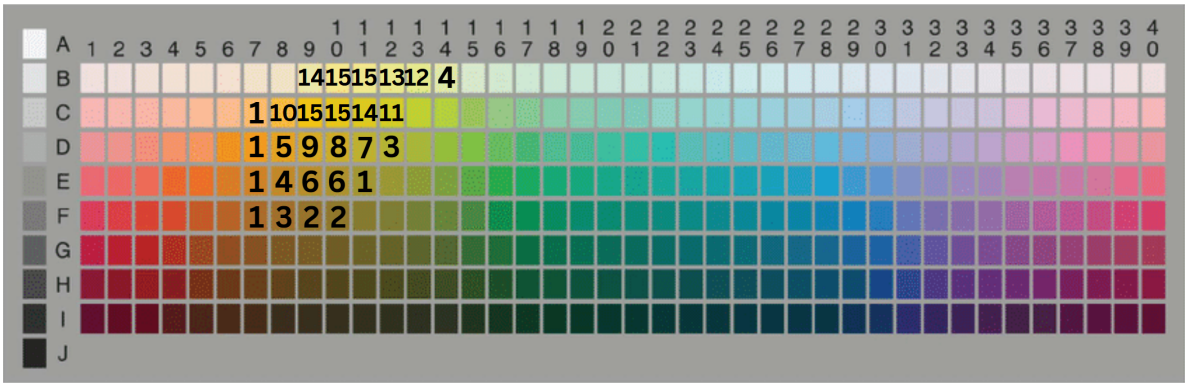

Figure 33: Boundary results for the color term *yellow.*

Green

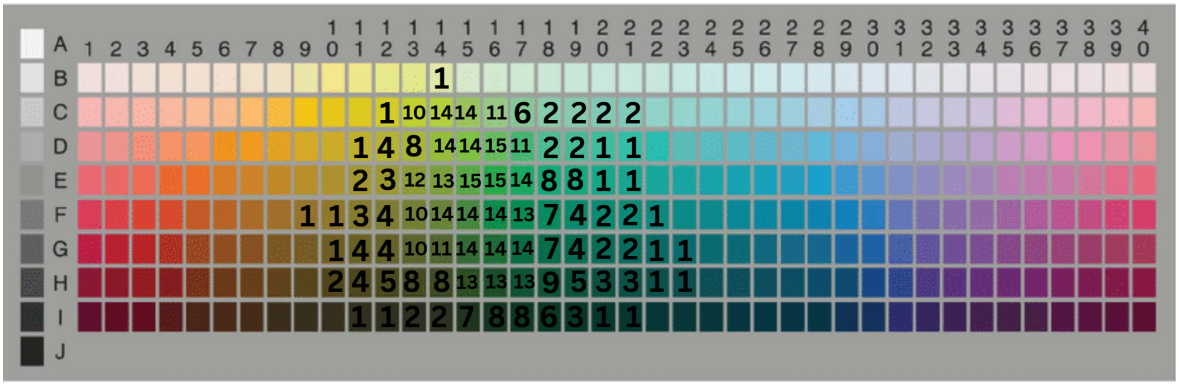

Figure 34: Boundary results for the color term *green*.

Pink

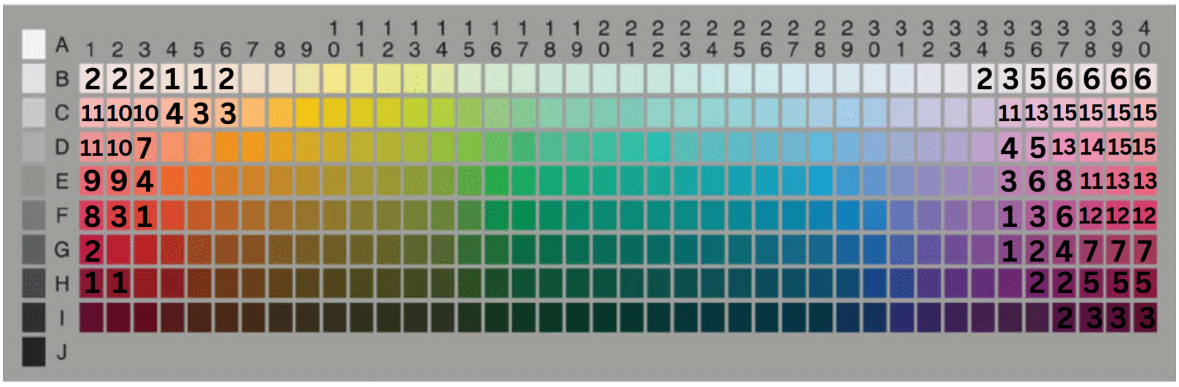

Figure 35: Boundary results for the color term *pink*.

Purple

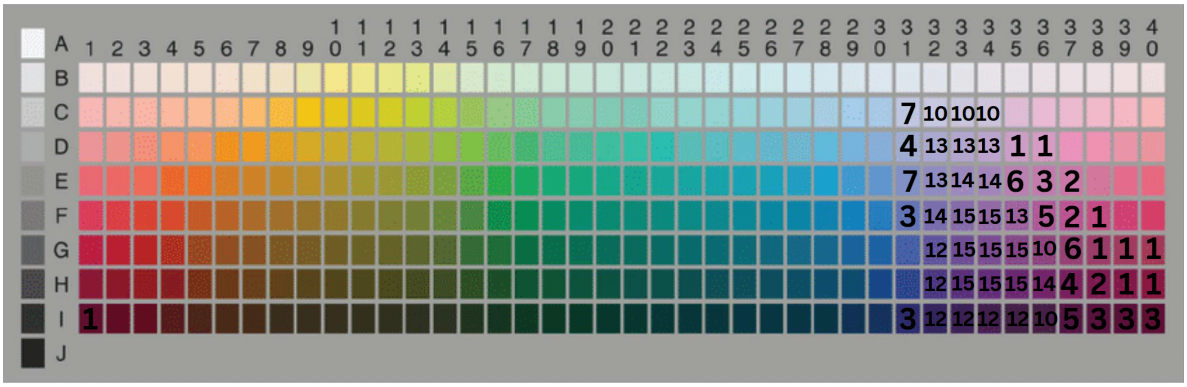

Figure 36: Boundary results for the color term *purple*.

Orange

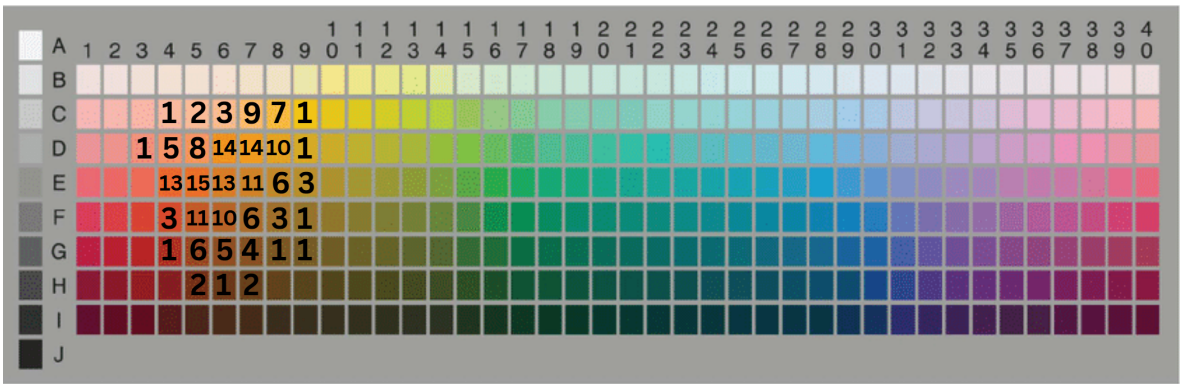

Figure 37: Boundary results for the color term *orange*.

Brown

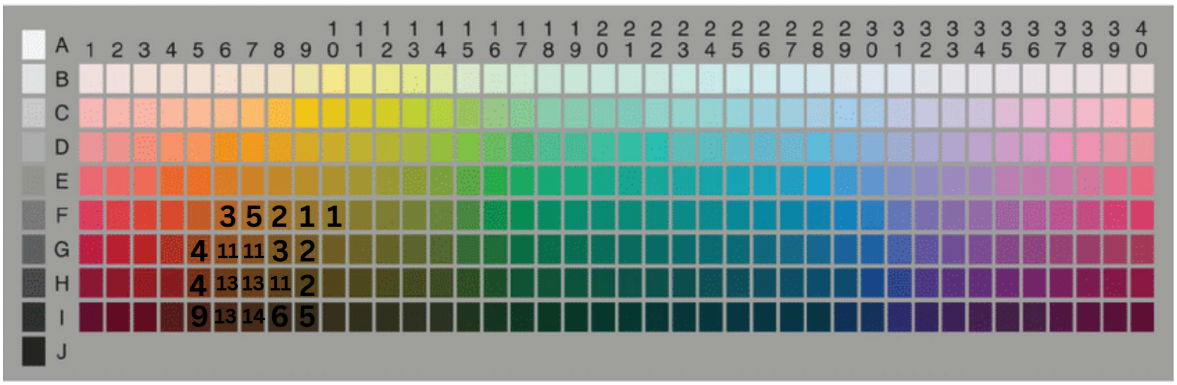

Figure 38: Boundary results for the color term *brown*.

Black

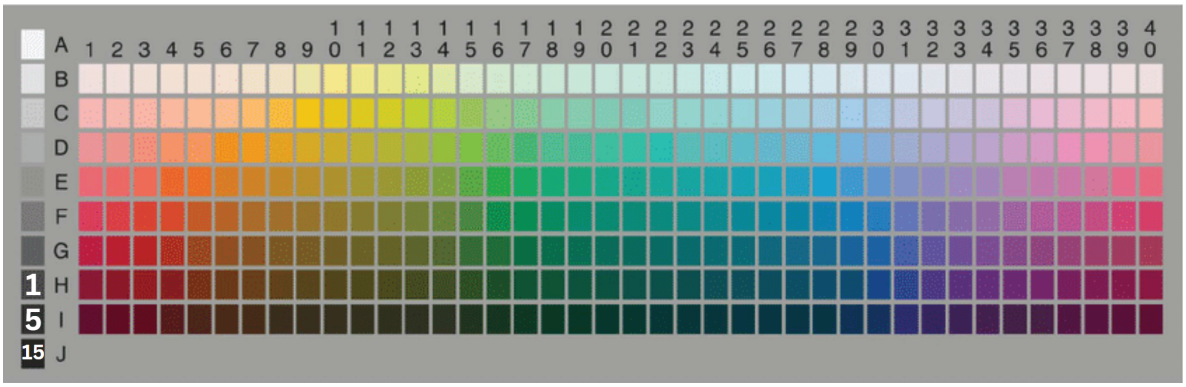

Figure 39: Boundary results for the color term *black*.

White

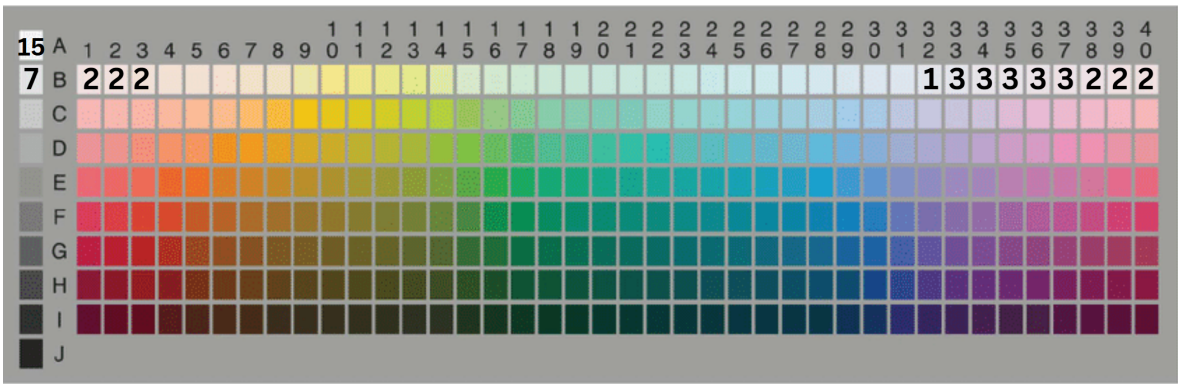

Figure 40: Boundary results for the color term *white.*

Gray

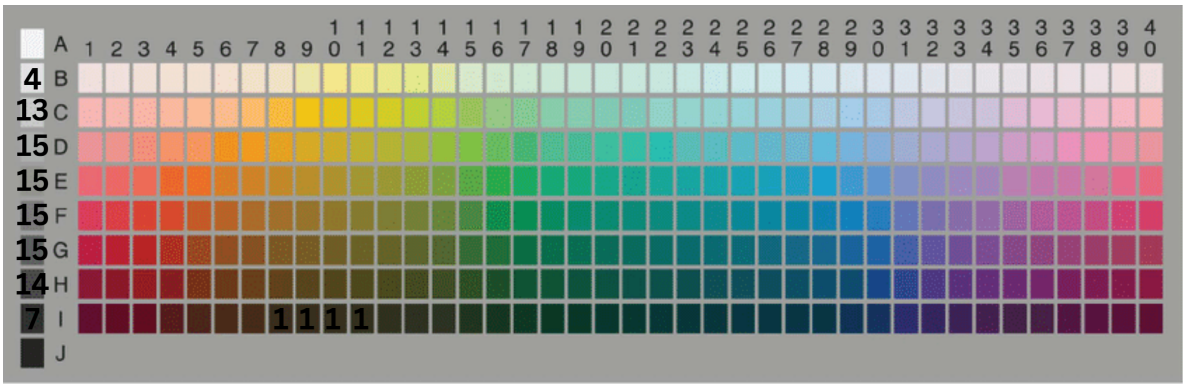

Figure 41: Boundary results for the color term *gray.*

4.6 Results of boundary task, Swedish

This section shows the results of the boundary task for the Swedish participants. This task only included the basic color terms, so the terms are presented here in the same order as they were shown to the participants. Each term is accompanied by an image of the Munsell color chart with numbered chips. The number on a chip indicates how many participants chose to include it in the relevant color term.

Röd

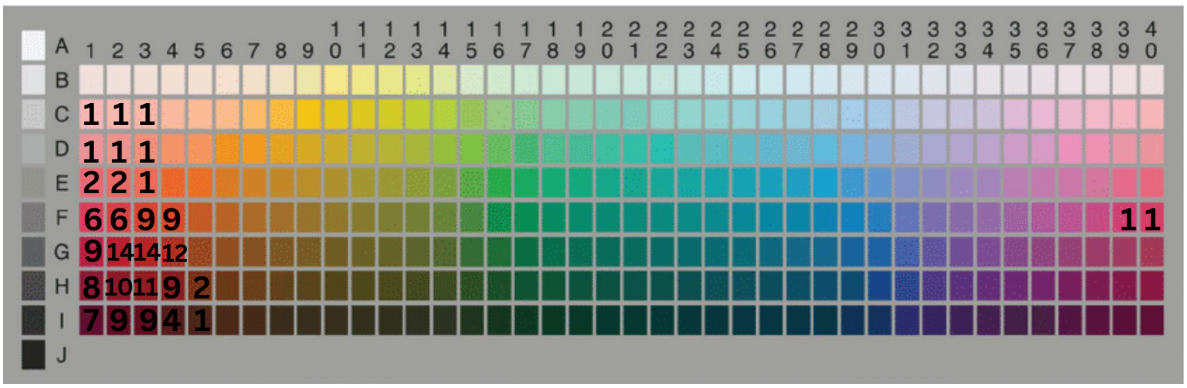

Figure 42: Boundary results for the color term *röd.*

Blå

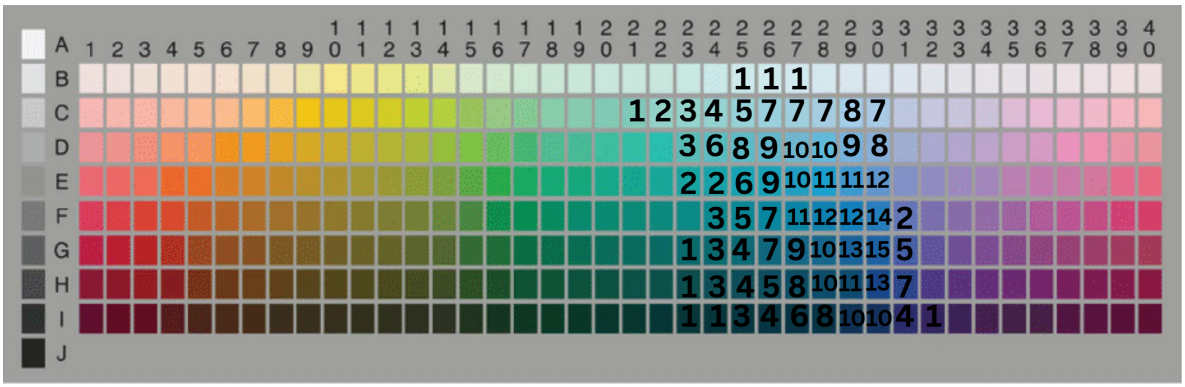

Figure 43: Boundary results for the color term *blå.*

Gul

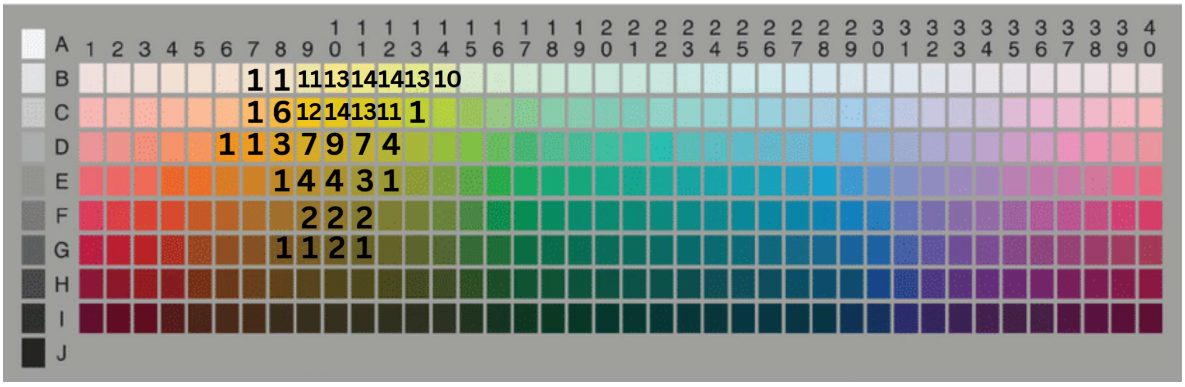

Figure 44: Boundary results for the color term *gul.*

Grön

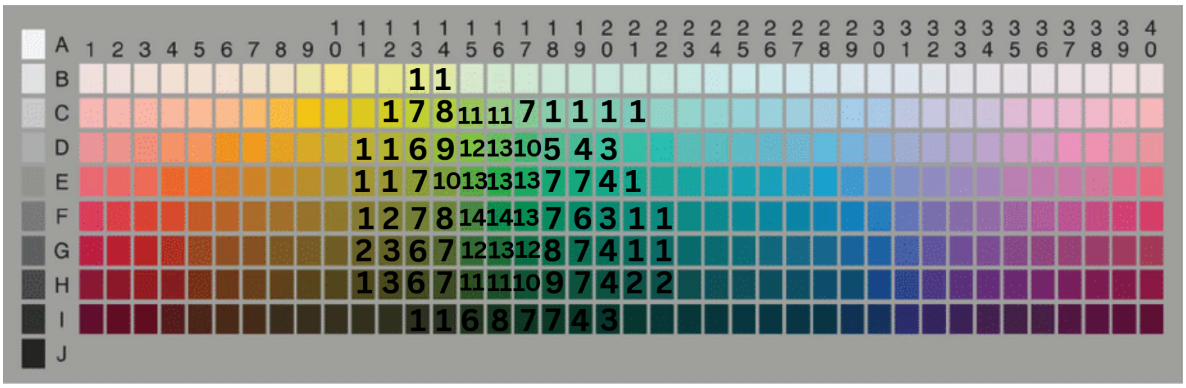

Figure 45: Boundary results for the color term *grön*.

Rosa

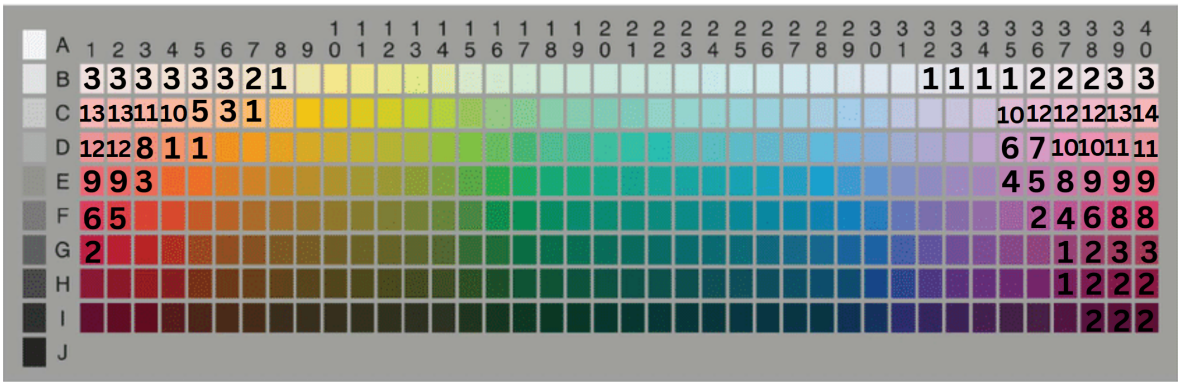

Figure 46: Boundary results for the color term *rosa*.

Lila

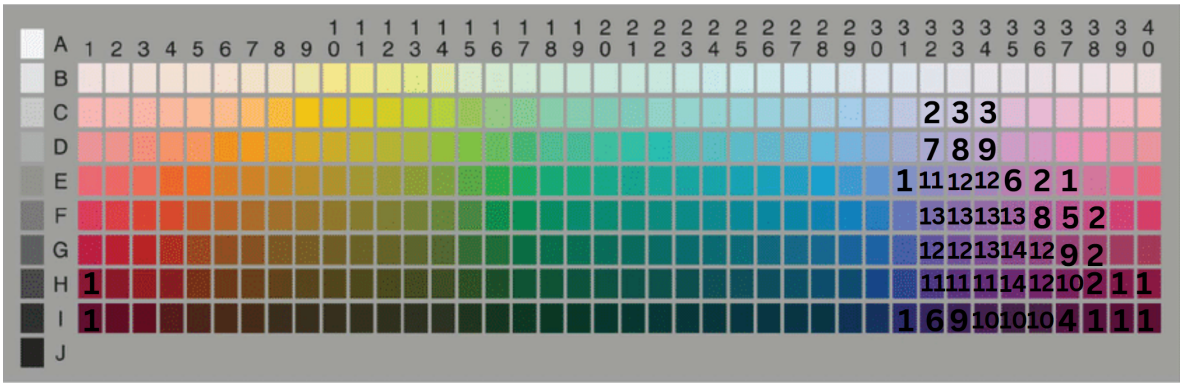

Figure 47: Boundary results for the color term *lila*.

Orange

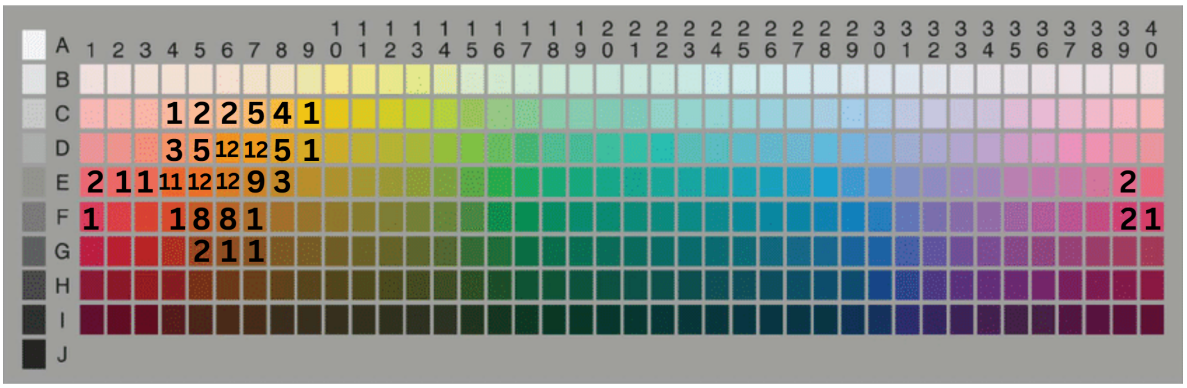

Figure 48: Boundary results for the color term *orange*.

Brun

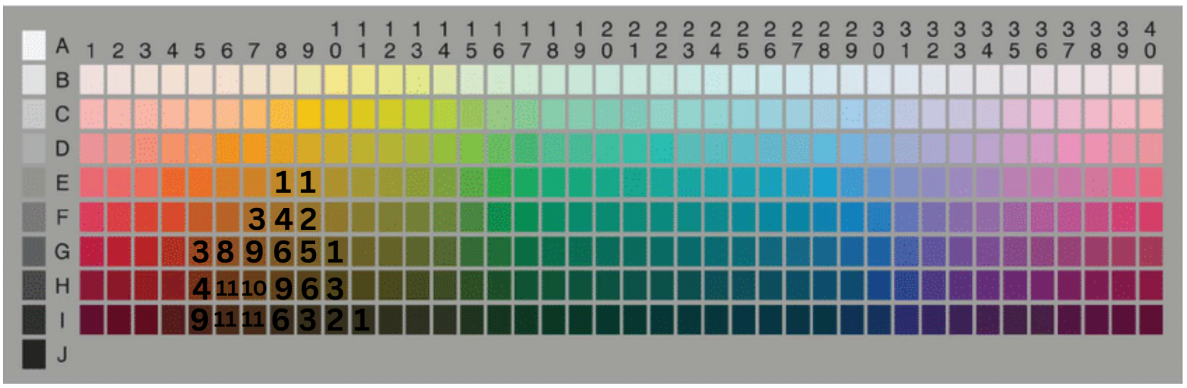

Figure 49: Boundary results for the color term *brun*.

Svart

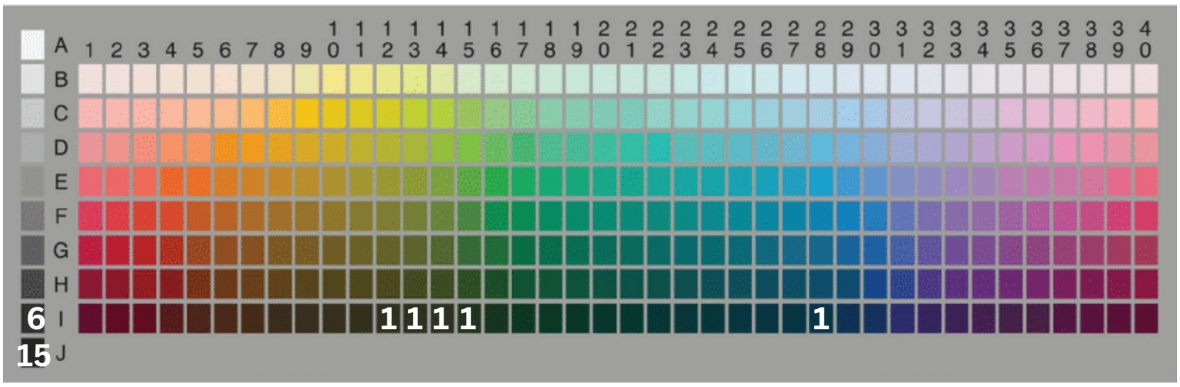

Figure 50: Boundary results for the color term *svart*.

Vit

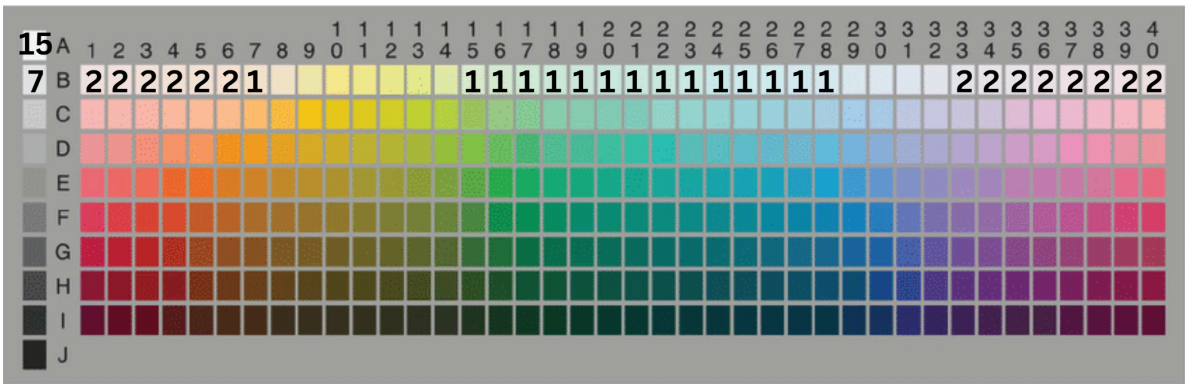

Figure 51: Boundary results for the color term *vit.*

Grå

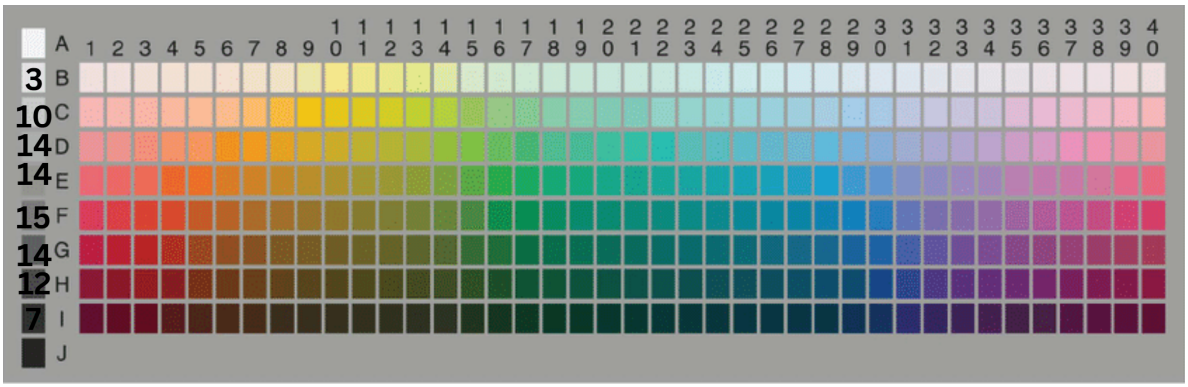

Figure 52: Boundary results for the color term *grå.*

5.7 Collective Results of Prototype and Boundary task for English and Swedish

This section combines the results of the previous sections to portray the collective results of the prototype and boundary tasks for both English and Swedish. This is done to optimally show the similarities and differences between the two languages and their semantic extensions. The collective modal chips of both languages are shown first, followed by the boundaries between the basic color terms.

5.7.1 The Modal Chips for Color Terms Listed by English and Swedish Speakers

This set of images shows all the modal chips for each of the color terms listed by more than half of the participants. The different modal chips are indicated by a frame with a connecting line to the color term.

English:

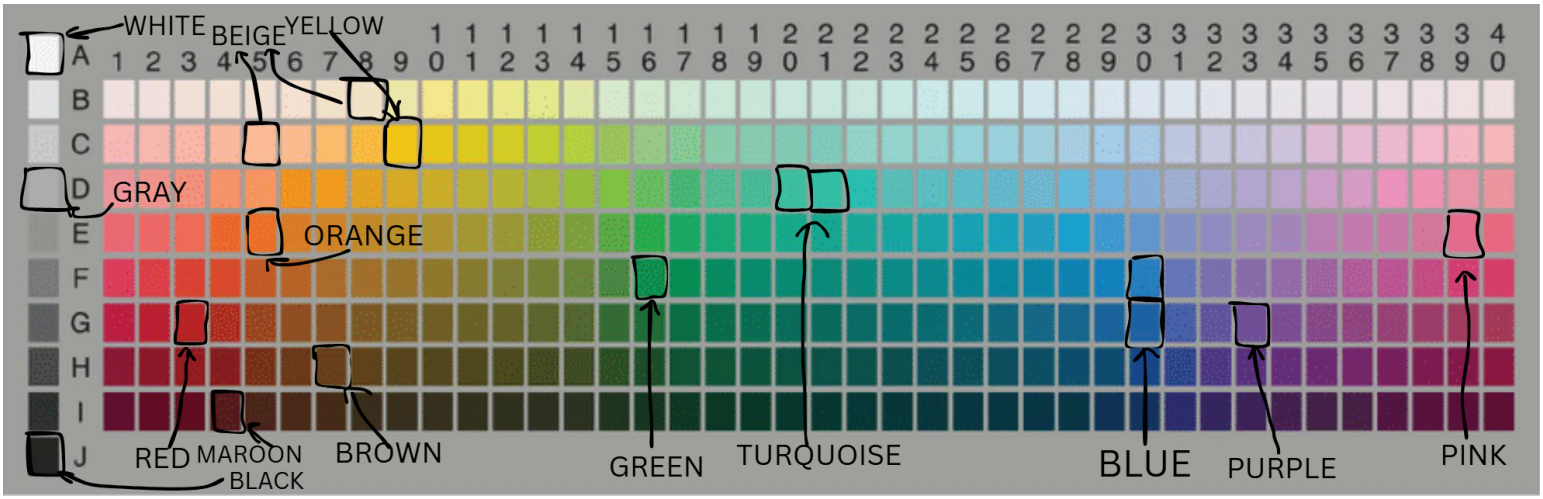

Figure 53: Modal chips for all color terms included in the English prototype results.

Swedish:

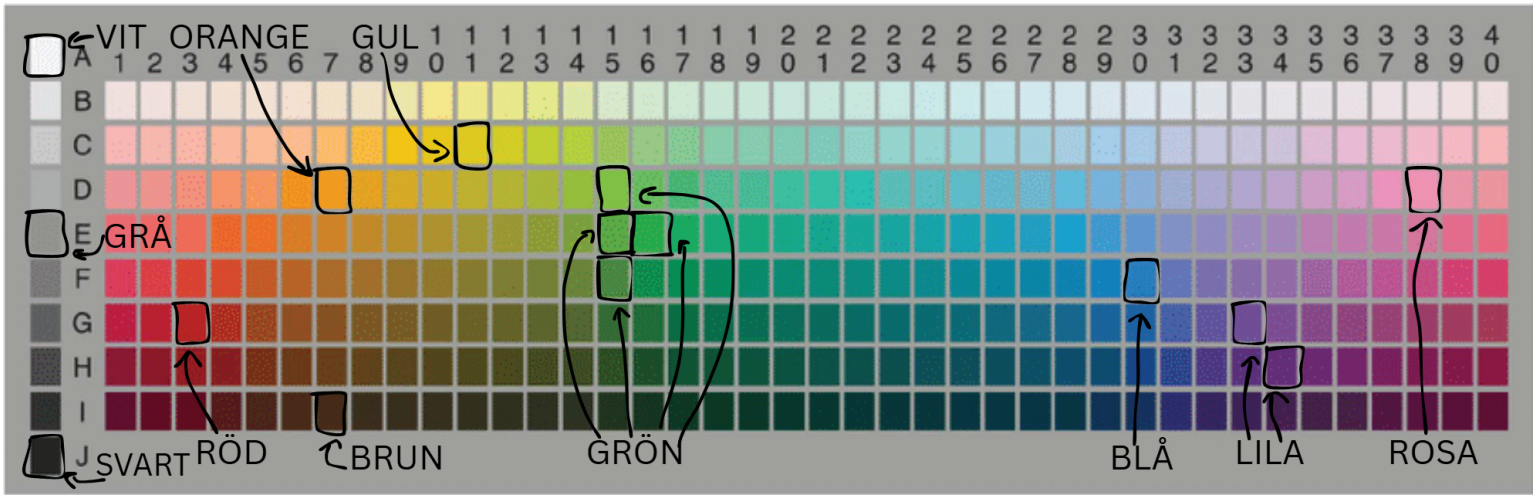

Figure 54: Modal chips for all color terms included in the Swedish prototype results[6].

[6] Note that since *turkos* did not have a modal chip it is not included in this chart.

5.7.2 The Boundaries of English and Swedish Basic Color Terms

This set of images shows the boundaries between all the English and Swedish basic color terms. The lines have been drawn based on what the majority of the participants included in their drawings for the different terms. For example, if a chip was included by 3 people in *yellow*, by 2 in *orange* and by 1 person in *pink*, that chip will be included in the *yellow* territory for this image. If a chip is included by the same number of participants in two colors, a line will be drawn through the chip, as can be seen with chips D and E 21 in Figure 55.

English:

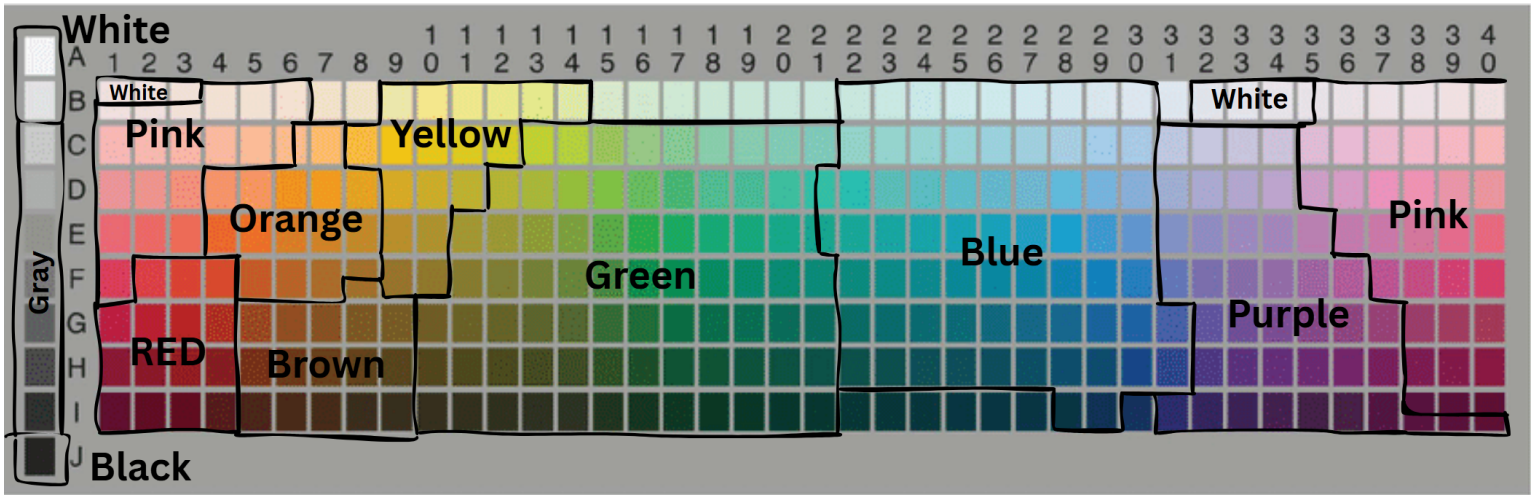

Figure 55: Boundary results for all English basic color terms.

Swedish:

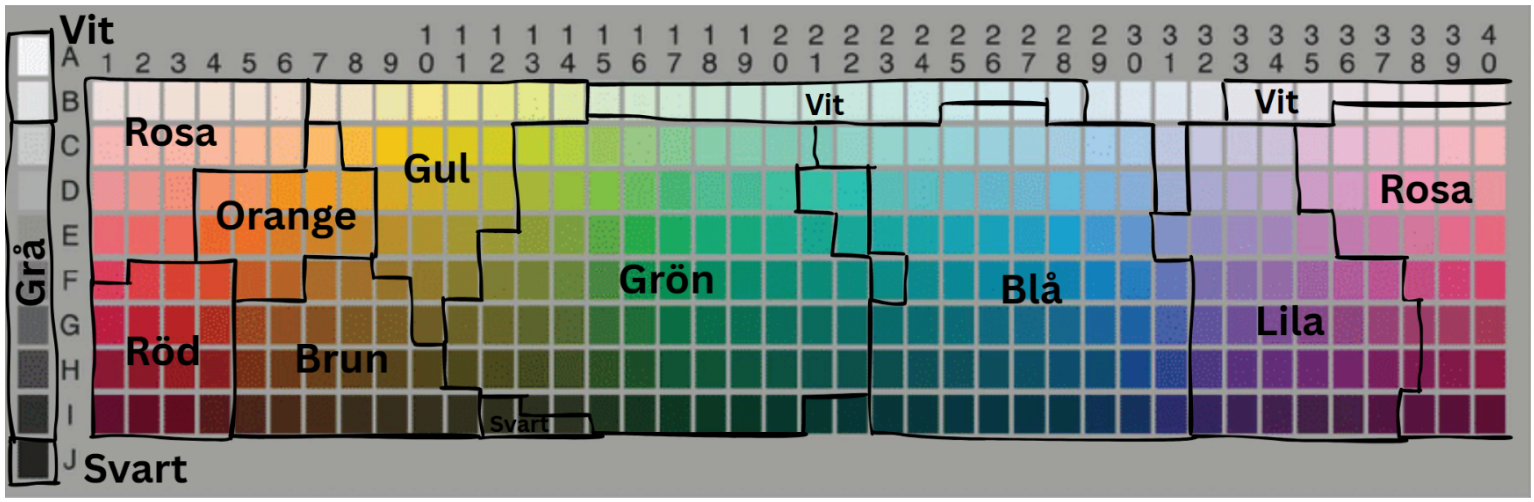

Figure 56: Boundary results for all Swedish basic color terms.

5. Discussion

The following section will cover the discussion of the results of the free elicitation task, the prototype task, and the boundary task for both English and Swedish. Comparisons between the two languages will be made to evaluate whether this data supports a universalist or relativist view of color encoding. Following this, the basic colors of English and Swedish will be reevaluated based on prior findings in combination with the current study. An attempt to fill the 13 logically possible primary color pairs with the color terms found in each language will also be made, based on the suggestions of Kay & McDaniel (1978). Finally, a problematization of the method will be done to discuss any factors that may have affected the results of the study.

5.1 Free Elicitation Task

This section will address the first research question: what color terms are most frequently listed by English and Swedish speakers. The participants from both languages listed about the same amount of color terms: 64 different terms were listed by the English speakers and 66 terms from the Swedish speakers. Individually, the English participants named between 11 and 34 different color terms with a mean amount of terms listed being 19.2, while the Swedish speakers varied between 11 and 27 terms each in the free elicitation task, with a mean number of terms listed being 18.8 terms. This means that both groups of participants on average named more terms than the 11 basic color terms originally proposed to exist by Berlin & Kay (1969) when asked for terms they use regularly. It also means that speakers of these languages use approximately the same amount of color terms daily which supports Conklin's (1973) statement about color vocabulary being linked to the general size of a language's vocabulary. Both English and Swedish are languages from technologically advanced societies, meaning both populations have a need for a larger color vocabulary to reference their environment.

In both languages, the top 11 most named color terms across the participants matched the 11 basic color terms established by Berlin & Kay (1969) which directly supports their claims about semantic universals within the domain of color. This finding is different from that of Mylonas & MacDonald (2016) whose results showed that colors like *turquoise, lilac,* and *violet* were listed more frequently than some basic color terms. It also differs from Sivik & Taft's (1997) finding

that Swedish speakers list *beige* both more and before the color *grå.* Not all participants had the basic color terms as their top 11 and some even left specific basic color terms out entirely from their list. While the number of terms the participants used did not differ much between English and Swedish, the color terms themselves did. In the English sample (see table 2), the color terms that were listed by all 15 participants were: *red, blue, green, white, purple, yellow,* and *black*. The color most frequently listed first by English speakers was *red*, which 7 different participants listed as their first color. *Red* was also the color term with the highest mean ranking on the participants lists (2.6) followed by *green* (4) and *blue* (4.4). The Swedish sample (see table 3) also only had 7 color terms that all participants included in their lists: *blå, grön, gul, röd, rosa, svart,* and *vit.* These are the same terms as the English participants except for the inclusion of *rosa* (pink) instead of *lila* (purple). The Swedish participants were also less unified in their first color on the list. The English participants placed either *red* (7) or *blue* (5) as their first color with a few outliers such as *white*, *pink* and *green* but the Swedish participants had *röd* (4), *blå* (3), and *grön* (3) as color terms most frequently placed first with outliers such as *grå, gul, svart,* and *rosa*. Swedish *röd* was also the color with the highest mean ranking in the Swedish sample (3.4), followed by *grön* (4.6) and *gul* (4.8). This means that the top 2 colors are the same in both Swedish and English while the third differs, being *blue* in English but *gul* in Swedish. This suggests that while English and Swedish have the same basic color terms, there are still differences in which colors we use most frequently. This finding could support a more relativist view, since there appears to be some cross-linguistic variation in the languages' color usage.

5.2 Prototype Task

This section concerns the second research question: What are the prototypes for the most frequently used color terms and to what extent are they similar in English and Swedish? The prototype task showed similarities between English and Swedish but also differences. In general, the English participants were more in agreement with each other on prototypes for each color term than the Swedish participants were. The color terms with the most similar prototypes in the two languages were *red/röd, blue/blå, white/vit, black/svart,* and *gray/grå. Red* (Figure 5) and *röd* (Figure 22) both had their prototype set as G3, but the English participants were much more in agreement on this. Most of them selected this exact chip, while only 4 Swedish participants chose it, F3 being a close second with 3 participants. This shows in the clusters around these two colors

as well, the English *red* has fewer dots than *röd* where the dots are also slightly more spread out. *Blue* (Figure 6) and *blå* (Figure 19) have the same pattern in their clusters, the Swedish *blå* is a bit more spread out than English *blue*. However, for this color the Swedish participants were more in agreement than the English participants who had a tie between two different chips. One of these, F30, was the same as Swedish *blå*, meaning that both *red/röd* and *blue/blå* are quite similar colors in these two languages. *White/vit* (Figure 8 and 25) and *black/svart* (Figure 11 and 24) were the only two colors that English and Swedish participants completely agreed on. All 30 collective participants selected chip A and J respectively for these two colors, but it should be noted that the amount of chips for these two colors is very limited in the scale and some participants expressed that neither of these were properly *white* or *black*, either not being clear and bright enough or pitch-dark enough. For *gray/grå* all participants also agreed that the prototype laid between D-G on the scale, but ultimately the English *gray* prototype was D, while E was selected by the most Swedish participants.

The rest of the color terms showed several differences in their prototype placements. For example, the English *yellow* (Figure 10) had its prototype placed as C9 while the Swedish *gul* (Figure 21) was C11. The *yellow/gul* clusters show that more Swedish participants seem to place *gul* closer to *green* while English speakers place it closer to *orange*. Once again, the English participants were more uniform in their selection than the Swedish participants. For *green* (Figure 7), most of the English speakers selected the exact same chip, F16, a chip that *none* of the Swedish participants selected as the prototype for *grön* (Figure 20). The Swedish participants were not in agreement at all on which chip should be the prototypical *grön* with a four-way tie between chips. In the free-elicitation task, many participants listed several different shades of *grön* as well, meaning that Swedish people might have a hard time deciding which specific shade of *grön* should be considered prototypical, perhaps because of the very green landscape of Sweden with its acres of forest.

Pink/rosa is a color that both English and Swedish speakers have difficulty agreeing on a prototype for. English *pink* (Figure 14) was placed at E39, while Swedish *rosa* (Figure 23) was placed at D38, two chips that are a bit different in shade. However, only 4 and 3 participants respectively selected these chips. As can be seen in the prototype clusters, participants generally agree on the

horizontal placement of *pink/rosa* while they disagree on how light or dark it should be. For *Purple/lila* (Figure 9 and 26) and Swedish had a tie between G33 and H34, the same chips that English participants selected the most and second most. As with *pink/rosa* though, there are only about 3-4 participants who chose the same chip. Participants seem to struggle to agree on both how light or dark prototypical *purple/lila* should be but also on how close to *pink/rosa* it should be. All participants of both languages agree that it should not be further than 31 on the horizontal axis in relation to *blue/blå*. *Orange* (Figure 12 and 28) for English participants was placed on E5, which is closer to the *red* chips while Swedish participants more often placed it on D7, which is closer to *gul*. This can be seen in both clusters as well where the English prototypes are a bit more concentrated in the area close to *red,* and a bit darker than the Swedish prototypes. *Brown/brun* (Figure 15 and 29) was also different between the two languages with English *brown*'s prototype being lighter than Swedish *brun*, but there was no majority who selected any chip in either of the two groups meaning the prototype for *brown/brun* is difficult for the participants to agree on as well. The clusters show that almost all of the participants agree on its horizontal placement within 4 coordinates situated at the darker parts of *red/yellow/green*, while the darkness and lightness of it is different between participants.

The last color that most of both English and Swedish participants listed in the free elicitation task was *turquoise/turkos* (Figure 16 and 30). In both groups of participants this was a color with a spread-out cluster. Only 2 participants in the English sample agreed on two different chips, D21 and D20, as the prototype, while no participant in the Swedish group selected the same chip as somebody else. The cluster for both colors shows that there is some agreement that the prototype should be on the lighter side of the scale, but not precisely where it should be located between *green/grön* and *blue/blå*. English *turquoise* seems to be placed a bit more towards the *green* area while some Swedish participants place *turkos* very far into the *blå* territory.

Lastly, most English participants also listed *beige* (Figure 17) and *maroon* (Figure 18) in their free elicitation lists. *Maroon* was placed by the majority as the chip I4 and all the selected prototypes can be found in the darkest area of *red,* on the coordinates 1-4 in H and I. *Beige* on the other hand is more spread out in the *white/yellow/pink* area. C5 and B8 were the only chips selected by two participants as the prototype. The cluster shows that participants mostly agree that *beige* is located

somewhere in the lightest part of the scale but have difficulty deciding on how far into the *yellow* territory the *beige* prototype should be located.

The results of this task do not necessarily support either universalism or relativism. While it is true that both languages created similar clusters with their selected prototypes around the same area for all the color terms like Berlin & Kay (1969) claim they should, there was also a lot of disagreement between the participants, even within the same language. The chip that was selected by the highest number of participants was G3 for *red*, chosen by 9 English participants. Almost no other modal chip was chosen even by a majority of the participants. The conclusion of this is that while speakers of both English and Swedish agree on the general area of a color term, agreeing on a specific hue and shade is extremely difficult, even for speakers of the same language. Therefore, these results support the notion of individual differences above both universalism and relativism.

5.3 Boundary Task

This section covers the third research question: What differences and similarities are there in the boundaries between the basic color terms in English and Swedish? Overall, the boundaries between the 11 basic colors in English and Swedish are similar (see Figure 55 and 56). *Red/röd*, *orange*, *purple/lila,* and *pink/rosa* have almost entirely the same boundaries and the line between *blue/blå* and *green/grön* is drawn in almost the same place. The English line is drawn between 21 and 22 while the Swedish line is between 22 and 23 on the horizontal axis, i.e. the hue value. *Black/svart*, *white/vit,* and *gray/grå* have the same boundaries with a few expectations from a small minority of participants who included some chips not from the grayscale in these colors. The noticeable difference is that Swedish *gul* and *brun* include more of the area English labeled as *green*. The fact that the boundaries between the 11 basic color terms are so similar is strong evidence for universalism, but once again there are evidently a few minor differences that argue against it. Any cross-linguistic differences found in color encoding supports the relativist view that our language shapes how we see and think about the world around us.

An interesting phenomenon from the boundary task is the gaps that can be seen in the color charts showing all boundaries between the basic color terms of English and Swedish. Note that when a chip is not included in a boundary on this chart it indicates that *none* of the participants included

it in *any* of the basic color terms. In the English color scale (Figure 55), there is a clear gap between the lightest shades of *pink* and *yellow* and two other gaps in the lightest and darkest parts of *green*/*blue* suggesting that more basic color terms are needed for these areas. On the Swedish color scale (Figure 56) there are also some smaller gaps in the lightest and darkest parts of *blå/grön* but also a clear gap between *blå* and *grön*. These boundaries are not drawn based on what the majority of the participants drew, if only one participant included a chip in their boundary of a color it is included in this overview. This means that based on the opinions of the majority of participants, these gaps would be even bigger, especially in the *blue/green* and *green/yellow* areas, precisely like Kay & McDaniel (1978) suggested in their study. We have very few terms to refer to such a big part of the color space that not all speakers are satisfied with using any of them for a range of color chips. A vast majority of the participants do not think the area between G-I on the vertical axis and 8-14 on the horizontal axis belongs to either *yellow, brown* or *green*, indicating there should be another basic color term to label this area properly.

5.4 Gender and Age Differences

This section does not address any of the research questions stated in the introduction but rather covers a few interesting findings related to gender and age. In the English data, the women named between 15 and 34 color terms (mean value 19.8) as opposed to the men who listed between 11 and 20 terms (mean score 18.2). The women in the Swedish sample listed between 12 and 27 terms with a mean value of 21.2 terms while the men named between 11 and 21 terms with a mean score of 16.6. Thereby, this data set supports the notion that women tend to use more color terms than men, especially in Swedish. As for the age groups, the youngest age group (18-39) in the English sample used between 11 and 34 terms with a mean amount of 19.3. The second age group (40-59) listed between 17 and 26 terms with a mean score of 21.3. Both participants belonging to the oldest age group (60+) listed 16 terms. For the Swedish sample, the youngest participants put between 12 and 27 terms on their lists, making their mean number of terms 19.8. The second group, the middle-aged participants, listed between 16 and 27 terms, the mean score being 20.8. Lastly, the oldest group of participants included between 11 and 19 terms on their lists with a mean number of 14.75 terms. This data shows that older people tend to use fewer color terms than younger participants, but the age group that use the most terms in their everyday life is those aged 40-60 in both English and Swedish.

In the boundary task the age of the participants seemed to cause some different decisions about color boundary to be made. In especially the Swedish sample the oldest participants, those aged over 60, included much fewer chips in their basic color term boundaries. For example, the images in figure 54 show the difference between a middle-aged Swedish woman and a senior Swedish man in how they indicated which chips to include in the color *grön*:

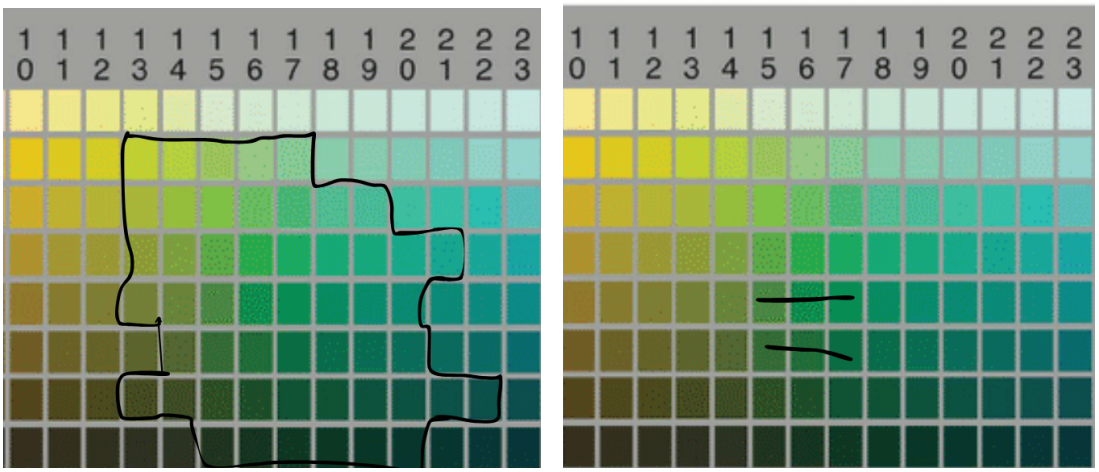

Figure 57: Comparison of the color term *grön* between a woman in age group 2 and a man in age group 3.

This pattern can be seen between most of the oldest participants and the younger, for all 11 colors except *vit, svart*, and *grå*. It is possible that this was an issue of mental energy required to make decisions between colors in this manner, but most of the older participants displayed the opposite mood. They wanted to hold long monologues about their thought process behind including different colors and excluding others and afterwards expressed their enjoyment of the tasks. It appears that this is a difference between speakers caused by age. Older speakers are much more restrictive in what shades they want to include in a basic color term than younger speakers are.

Since gender and age differences were not primary points of interest for this study and therefore no variables were manipulated in the tasks to find specific differences, a suggestion for more research specifically focused on this is made here. There is much previous research on gender differences in color usage (e.g. Thomas et al., 1978; Radeloff, 1990; Green, 1995), but age is less commonly the focus of color terminology studies. Interviewing older speakers also could reveal older color terms that are no longer used in a widespread way.

5.5 The Basic Color Terms of English and Swedish

This section deals with the fourth and fifth research questions by first establishing which of the 11 Berlin & Kay (1969) basic color terms are found in English and Swedish and then examining the secondary color terms frequently listed by the participants to determine if any of them should be considered basic as well.

To determine which of the most frequently listed color terms can be labeled basic color terms of each language we return to Berlin & Kay's (1969) criteria for basicness:

1) The term must be monolexemic.
2) The term's signification is not included in any other color term.
3) The term's usage cannot be restricted to a narrow class of objects.
4) The term must be psychologically salient to informants, i.e. it must be used by most of the speakers of a language.

(Berlin & Kay, 1969).

5.5.1 The English Basic Color Terms

The English sample of this study can confirm the 11 basic color terms proposed to exist in a stage 7 language. All 11 of these terms were listed by most of the participants. The question is whether any of the other color terms listed by the participants should also be considered a basic color term. The background covered many studies where this has been the topic and colors such as *turquoise*, *lilac, teal, peach, lavender* and *maroon* have been argued to be basic (Mylonas & MacDonald, 2016; Lindsey & Brown, 2014). For this study, the color terms that could pass the fourth salience criteria are *turquoise, beige,* and *maroon*, all of which were listed by at least half of the participants. All three of these are monolexemic, and none of them are restricted in its usage, so the remaining question is whether their signification is included in any other color term. Examining the results of the prototype task shows that all three of these terms were given different clusters than the basic color terms, *turquoise* being placed between *green* and *blue*, *maroon* in the darkest part of *red* and *beige* somewhere between *pink* and *yellow*. This suggests that the "truest" shade of these colors is not the same as the prototype for other basic colors. In the boundary task, some participants grouped these colors in with the basic color terms, but not the majority. For *maroon*, 6 out of the

15 participants included the prototypical *maroon* in red, while the rest left it out and did not include it in any other basic color either. As for *turquoise*, there is an area in the lighter parts between *blue* and *green* where the vast majority of participants have declined to include chips in either *blue* or *green*, suggesting they would like to use another color term to refer to those chips. Lastly for *beige*, there is an area in the color space around *pink* and *yellow* that was left out completely by all participants that coincides with the area many participants placed the prototypical *beige* in.

The primary issue for these terms to qualify as basic would be that participants were not in as much agreement on what the prototype of the color looks like compared to the basic color terms. Both *beige* and *turquoise* do not form as clear clusters around a certain area as other colors, but for *beige* this could very likely be because the color space does not represent the color well enough, as many participants indicated during the task. For *turquoise*, the issue seems to be that participants cannot agree on how light or dark the color is, but the majority placed it in approximately the same space between *blue* and *green* which is also the same space many left empty in the boundary task. *Maroon* does not have this same issue, most participants even selected the exact same chip as the prototype, but on the other hand more people included this chip in another color term.

All three of these terms have also been found by previous studies to be promising candidates for including in the basic color term category (Rich, 1977; Boynton & Olson, 1990; Simpson & Tarrant, 1991; Lindsey & Brown, 2014; Mylonas & MacDonald, 2016). The fact that several different groups of English speakers treat these terms in a similar manner is promising, but there are evidently large differences between groups of participants despite this. Many of the colors that other studies claim could be a basic color term are color terms that were only mentioned by a few or by none. For example, *lilac* as suggested by Mylonas & MacDonald (2016) was only listed by 5 participants in this study, Boynton & Olson's (1987) *peach* was only listed by 2 participants, Sturges & Whitfield's (1995) *cream* was listed by only 3 participants, and Lindsey & Brown's (2014) *teal* and *lavender* were included on only 4 and 5 participants' lists respectively. *Turquoise, beige,* and *maroon* have strong arguments for being included in the category of basic color terms based on the Berlin & Kay criteria (1969), but there are also arguments to be found against their inclusion.

5.4.2 The Swedish Basic Color Terms

Since, at the time of writing this, no study has been conducted to determine the basic color terms in Swedish, the data from this study can now support that they are very likely the same as the English basic color terms. All Swedish equivalences of the 11 basic color terms found in English were the most salient color terms to the participants. Table 3 shows that the top 11 terms with the greatest number of occurrences coincides with the 11 Berlin & Kay (1969) claims exists in stage 7 languages. With this as a basis, the next step is to examine the secondary colors to determine if any of them could also be included in the basic color term category.

In the Swedish sample, only one color other than the basic color terms were mentioned by more than half of the participants, *turkos* so using the Berlin & Kay (1969) criteria for basicness we can evaluate this terms categorization. It is monolexemic and not restricted in its usage, and there is a gap between *blå* and *grön* that majority of the participants left unfilled. There are even a few chips *no* participants placed into *blå* or *grön* or any other color term. The biggest issue for *turkos* is that while the majority of the participants listed it, there is no clear agreement on its specific placement on the color space. It is consistently placed in the 'empty' space between *grön* and *blå*, but none of the participants selected the exact same chip as the prototype, so the cluster is much bigger and less concentrated than the clusters of other basic color terms.

A few Swedish participants also listed the Swedish equivalents of *maroon* and *beige*, those being *vinröd* and *beige*, so those are commonly used color terms in Swedish just like in English, but not by enough participants to be considered salient. *Vinröd* is also not monolexemic, it contains the words *wine* and *red* meaning it could not classify as basic based on Berlin & Kay's (1969) criteria. *Beige* could qualify, but unlike in English there is no completely empty space in the color space for Swedish *beige*. The space where English *beige* is placed has not been filled by most of the Swedish participants, but those chips have been included in the boundaries of both *gul*, *rosa* and even *white* by a few of the participants. This goes against the results of Sivik & Taft (1997) whose participants listed *beige* very frequently in their free elicitation tasks, suggesting *beige* could be a basic color term in Swedish. In this study it was only listed by 6 out of 15 participants, i.e., not even a majority.

Sivik & Taft in their 1994 study on Swedish color terms used 16 different "common color names": *vit - white, svart - black, gul - yellow, röd - red, blå - blue, grön - green, grå - gray, brun - brown, lila - purple, orange - orange, violett - purple, skär - pink, rosa - pink, olivgrön - olive-green, purpur - purple, beige - beige.* In the current study, *vit, svart, gul, röd, blå, grön, grå, brun, lila, orange,* and *rosa* were used by most participants, along with *turkos*, but none of the other color terms that Sivik & Taft (1994) used were mentioned by a majority in this study. Some of these terms are older color terms that appear to have slowly been replaced in Swedish. *Skär*, *violett, purpur,* and *brandgul* are all examples of such terms, and in this study only *violett* was mentioned by a significant number of participants (7). After discussing some with the older Swedish participants, it seems as though *skär* has been almost completely replaced by *rosa*, even in their age group. *Brandgul* was mentioned by two participants, but both stated that it has a very restricted usage, *gul* and *orange* have largely replaced that term as well. *Violett* and *purpur* are both variations of *lila*, so most people opt to use that term instead. The participants who listed *violett* seemed unsure of the difference between *lila* and *violett* when selecting prototypes, but generally placed *violett* as a slightly darker shade than *lila*.

5.6 Filling the Color Space

This section answers the sixth and last research question: how many of the logical primary color pairs the color terms of English and Swedish can fill. The basic color terms of English and Swedish the same, both have the Stage 7 11 basic color terms from Berlin & Kay (1969) with a few secondary colors as candidates for being included in the basic color category: *turquoise* and *turkos* for both languages and *maroon* and *beige* for English. This still only equates to a maximum of 14 basic color terms in the case of English as opposed to the 19 possible terms stated by Kay & McDaniel (1978). If the search for terms is extended beyond these color terms, the question is if either English or Swedish could completely fill the vocabulary of 19 possible terms.

5.6.1 The English Color Space

Beginning with English, we already have black-yellow: *brown*, yellow-red: *orange*, white-red: *pink*, red-blue: *purple*, and white-black: *gray*. Adding *turquoise*, *maroon*, and *beige* to those fills the blue-green, red-black, and white-yellow spots. For the black-blue pair, *navy*(*blue)* is a color term whose prototype was consistently placed in the very darkest part of the blue color space by 7

participants. The issue with making this a basic color term is that many participants labeled it as *navy-blue*, in other words a *shade* of blue rather than a separate color. The same issue occurs for the potential candidate of the white-blue pair: *sky-blue*. *Sage(green)* could possibly be a suggestion for the white-green pair, but again, most participants use the term in combination with *green* to indicate a shade rather than a basic color term. *Emerald green* or *forest green* for black-green and *lime(green)* for green-yellow both have the same issue. The one color term that could fill the green-yellow pair successfully is *chartreuse*, a monolexemic term without any other color term included in it. The issue here is that in this study at least, the few who listed *chartreuse* placed its prototype in an area most of the participants included in their boundaries of *green*, and some participants even selected that exact same chip as their prototype for *green* meaning the referent to chartreuse is included in *green* and it can therefore not be a basic color term.

5.6.2 The Swedish Color Space

Turning to Swedish, based on the results discussed previously, the same 11 basic color terms as English can be established as a base for attempting to fill the color space. *Turkos* is a good candidate for blue-green and *beige* can fill the white-yellow space. Unlike *maroon* for English though, Swedish *vinröd* is not fit to fill the red-black spot since it is not monolexemic and includes another color term in its name, indicating it is just a shade. This pattern can be found across most of the other color pairs as well, *mintgrön* for white-green, *himmelsblå* for white-blue, *marinblå* for blue-black, and *limegrön* for green-yellow. Some of these could be used without the *blå* or *grön* attached, but the fact still stands that most speakers use these colors as shades of a basic color term, not a basic color term in and of itself. The exception to this is the spot for black-green, which could be filled by the term *petroleum*. This term fills all the criteria for basicness except one, it is not used by a majority of the participants. If we disregard the salience criteria for basic color terms, English could fill 15 (adding *turquoise, maroon, beige* and *chartreuse*) out of the 19 basic color terms and Swedish could fill 14 (adding *turkos, beige,* and *petroleum*).

5.7 Problematization

This last section of the discussion covers the few conditions of this study that could have affected the results. Firstly, because this study was conducted in Sweden, the Swedish sample of participants is more mixed between genders and ages while the English sample is primarily

students since those are generally the type of native English speakers temporarily residing in Sweden. A consequence of this is that the English sample may be biased towards how color is mentally represented and used by students rather than by an entire population of speakers.

A potential issue of the free elicitation task is that it does not necessarily accurately represent what colors are the most salient to the participants. The very first color on the list might be based on salience, but the rest of the list shows that many participants may have created a list 'by association'. For example, some may start with *red*, then follow that up with other shades of red through association, rather than in the order of what colors they use most frequently. This is something some participants themselves reflected on after finishing the tasks. A way to avoid this would have been to use an alternative method, such as showing participants the chips of the Munsell scale and asking them to name them all individually, however, the decision was made that this would be too time consuming and mentally taxing on the participants. The boundary task may have had a similar issue, some participants mentioned how they might have either included or excluded certain chips in different color terms if they were shown the chip individually instead of in an array of chips. Again, it might have been beneficial to show the participants all the chips one by one for the boundary task too, but that would have tired the participants much faster. Almost all participants had feedback after the task that was very positive, the length of the session was good, and the tasks themselves were not mentally taxing. Only some of the older participants appeared to tire by the end of the session, meaning if I had used the alternative method I would not have been able to ask older persons to participate.

Because of the different ages and characteristics of the participants, it was unfortunately not possible to ensure that all participants had the exact same viewing distance when performing these tasks. While all participants are confirmed to have a normal color vision, other factors still cause some participants to need a closer view of the laptop screen than others. In some cases, especially for the older participants, they wished for the researcher to draw the lines in the boundary task, meaning their position was further away from the screen while the drawing took place than those who did it themselves.

Lastly, many participants had complaints about the Munsell color chart. Some complained about the dots that can be seen in some of the squares, to the degree that they sometimes refrained from picking it as the prototype for a color. Both *brown* and *beige* were also often mentioned as not accurately represented in the scale. This may explain why the prototypes for *beige* especially did not form a clear cluster and why the Swedish boundaries did not leave a gap for that color. The chips on the scale simply did not include a proper *beige*. *Bronze*, *silver*, and *gold* were also underrepresented according to the participants who listed those colors. Their exclusion from the scale is logical to some extent since many scholars regard these as materials and not colors, but the participants who included them on their list were asked whether they would use these terms for any item regardless of its material and many replied that they would. It appears the consensus is that the referent needs to be shiny in appearance, but not actually made of metal. *Pink* being separated and therefore present on both sides of the scale sometimes caused confusion for participants who missed the chips on the left side of the scale. Many participants also needed to have the gray scale on the very left side pointed out to them so they would not miss it while picking prototypes for *white*, *black*, and *gray*.

6. Conclusion

The findings of this study show that while English and Swedish speakers seem to use approximately the same amount of color terms, there are differences in what they are referring to when using certain color terms. Both English and Swedish participants listed a collective amount of between 60-70 color terms with an average of 18-19 terms per speaker and the current basic color terminology includes the 11 color terms suggested by Berlin & Kay (1969) in both languages. In the prototype task though it can be seen that English speakers are much more in agreement on the best example of the most frequently used color terms than the Swedish participants were. While the languages had the same chip as the prototype for some colors like *red/röd* and *blue/blå*, other colors like *pink/rosa* and *brown/brun* had different prototypes. The boundary task showed similarities between the languages like the boundaries for colors like *red/röd*, *pink/rosa* and *purple/lila* being almost the same, but other boundaries differed between the languages, such as *brown/brun* and *yellow/gul*. Both English and Swedish had gaps in the color space after inserting the boundaries between the basic color terms, English in the *pink/white/yellow* area and Swedish in the *grön/blå* area among others.

These gaps were relevant in answering the question of whether these languages may have more than 11 basic color terms. For English, *turquoise, beige,* and *maroon* were colors that were listed by more than half of the participants and for Swedish, *turkos* could also be considered for the position of a basic color term. The gaps in the color space along with the clusters of the prototypes for these colors argue for them being included in the basic color categories, while the lack of agreement on an exact chip as the prototype argues against their inclusion. This study also did not find many of the other colors suggested by previous studies to be basic being listed frequently by speakers, for example *lilac, teal, cream,* and *peach.* If *turquoise/turkos, maroon,* and *beige* are included in the basic color terms, English could fill more of the color space, leaving only the white-green, black-green, white-blue, black-blue, and yellow-green pairs empty. Swedish is still missing a few more basic color terms, but by extending the search beyond colors listed by a majority, Swedish has some color terms that could fill some the remaining color pairs, for example *petroleum* for black-green. Despite the inclusion of these terms though, there are still gaps in the

color space for both English and Swedish and more studies should be conducted to eventually fill these gaps and complete the basic color terminology for the entire color space.

The conclusion that can be drawn from the data and discussion of this thesis is that comparing two languages from technologically advanced countries that are also close geographically and genealogically shows arguments for both universalism and relativism. While English and Swedish use many of the same color terms, even having the same basic color terms, the exact prototype for all these color terms and the boundaries between them are not the same. It seems as though universalism and the evolutionary stages of Berlin & Kay (1969) can be applied to the color terminology, but concerning the actual view and usage of these terms, there is a case for relativism to be made. It should be noted that above all this, there seems to be a lot of individual differences in how people perceive color which aligns with Mylonas & MacDonald's (2016) observations. While patterns could be found between English and Swedish and even gender and age, there was a lot of individual variation for all three tasks. For many of the colors fewer than 5 participants agreed on the same chip as the prototype and in the boundary task there were only a few chips that were included in a color by all 15 participants. While there are elements of both universalism and relativism in color usage, these findings suggest that above both of those theories, humans are very individual in how they semantically represent and use color, most likely created by their individual opinions and experiences.

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Appendix A

Participant sheet and task instructions, English

Participant code:

Age:

Gender:

Occupation:

Native language:

Other languages. Please also indicate approximately how often you use it (i.e. every day, every week, every month, etc.) and at what age you learned it:

Task 1

Instructions: Please list as many colors in English as you can think of in the order you think of them.

Criteria:

- The color name must be a single word. (Phrases including words like light and dark, and phrases with intrinsic modifiers like -ish are not acceptable.)

- The word must be a general color name, applicable to anything of that color. (Blond, for example, is not such a word, as it is used to name the color of hair, furniture, or beer, but not, for example, a car or a potato.)

- The word must be one that you would normally use to name the color of something in your everyday life. (I am not testing for how many different color names you know or can dream up, or how many subtle distinctions in color you can name.)

Task 2

Instructions: For each term you wrote down in the previous task, point to the chip in the color chart that you think is the best example of the term. For example, for blue, point to the most blue or the bluest blue chip in the chart.

Task 3

Instructions: For each of the colors labeled at the top of the page, please indicate through drawing lines what color chips you would include in that term.

Appendix B

Participant sheet and task instructions, Swedish

Deltagarkod:

Ålder:

Kön:

Sysselsättning:

Modersmål:

Andra språk. Var god indikera ungefär hur ofta du använder språket (t.ex. Varje dag, varje vecka, varje månad osv.) samt vid vilken ålder du började lära dig språket:

Uppgift 1

Instruktioner: var god skriv ner så många svenska färger du kan komma på, i ordningen du kommer på dom.

Kriterier:

- Färgtermen måste bestå av endast ett ord. (Fraser som inkluderar ord som ljus eller mörk eller fraser med inneboende modifierare som -aktig skall icke listas).

- Ordet måste vara ett allmänt färgord som kan användas för allt i den färgen. (Blond, till exempel, räknas inte som ett sådant ord eftersom det används för att benämna hår, men inte en bil eller en potatis.)

- Ordet måste vara ett som du vanligtvis använder för att benämna färgen på något i din vardag. (Jag är inte ute efter att testa hur många färger du kan eller kan hitta på, eller hur många subtila distinktioner du inom färg du kan benämna.)

Uppgift 2

Instruktioner: För varje term du skrev ner i den förra uppgiften, peka på det chip i färgskalan som du tycker är det bästa exemplet för termen. T.ex. för blå, peka på den som är mest blå eller den blåaste blå i skalan.

Uppgift 3

Instruktioner: För varje ord som står längst upp på sidan, var god indikera genom ritade linjer vilka färg chip du skulle inkludera i den termen.

Appendix C

Informed Consent Form

Title of Research: English and Swedish Color Terms

Name and Position of Investigator: Nellie Briskog, Master's Student

Supervisor: Professor Panos Athanasopoulos, Centre for Languages and Literature, Lund University.

The nature of the research project

This project is in the research area of cognitive science (the science of how the mind works when humans think and process information). We are investigating the effects of linguistic and/or cultural background on people's perception of color. You will be asked to complete a series of very brief, simple tasks. Specific instructions will be given before you start each task. You may ask questions or withdraw at any point during the task.

Confidentiality and anonymity

We very much appreciate your help with our research. Your results will be treated in a confidential and anonymous manner. Should you have additional questions about the study and/or require information regarding the final research results please contact Professor Panos Athanasopoulos, Lund University, Centre for Languages and Literature, Box 201, SE-221 00 Lund, Sweden. panos.athanasopoulos@englund.lu.se

"I agree to participate in this study. I have been given time to read this form and had a chance to read it."

Signature: _____

Date: _____

Signature of Investigator: _____

Appendix D

Informerat Samtyckesformulär

Titel på Projektet: English and Swedish Color Terms

Namn och Forskares Position: Nellie Briskog, Master's Student

Handledare: Professor Panos Athanasopoulos, Centre for Languages and Literature, Lund University.

Projektets Innehåll

Det här projektet utförs inom ämnet kognitiv vetenskap (vetenskapen om hur vårt sinne fungerar när människor tänker och bearbetar information). Vi undersöker effekten av lingvistisk och/eller kulturell bakgrund har på människors uppfattning av färg. Du kommer att få utföra en serie korta och simpla uppgifter. Specifika instruktioner kommer ges innan du börjar varje uppgift. Du kan ställa frågor eller avbryta när som helst under uppgiften.

Sekretess och anonymitet

Vi uppskattar väldigt mycket att du vill hjälpa oss med vår forskning. Dina resultat kommer att behandlas under sekretess och på ett anonymt sätt. Skulle du ha några frågor om studien och/eller de slutgiltiga resultaten, var god kontakta Professor Panos Athanasopoulos, Lund University, Centre for Languages and Literature, Box 201, SE-221 00 Lund, Sweden. panos.athanasopoulos@englund.lu.se

"Jag samtycker till att delta i den här studien. Jag har blivit given tid nog att läsa igenom det här formuläret och har fått chansen att läsa det."

Signatur: _____

Datum: _____

Forskares signatur: _____

Appendix E

Chips selected as prototypes for chips listed by less than half of English participants:

The chips are presented in order of frequency and the number of participants who selected it as the prototype can be seen in parenthesis. The chips without a number in parenthesis were selected by only one participant.

Navy:

1. I29(5)
2. I30, H30

Magenta:

1. F40(2)
2. G40, F39, H40, F1

Lavender:

1. H33, D34, E31, C33, E33

Lilac:

1. D33(3)
2. D34, G33

Cyan:

1. D25, F24, H30, E20

Burgundy:

1. I4(2)
2. I1, I3

Teal:

1. D22, D18, E24, F19

Violet:

1. H32(2)
2. I35, G33

Lime:

1. D15(4)

Silver:

1. F, C, E

Gold

1. G7, D10, C8

Cream:

1. B3, B8, B2

Periwinkle:

1. C30, C26, E31

Chartreuse:

1. C16, D15, D13

Forest green:

1. I15, G13, I18

Scarlet:

1. F3(2)
2. H1

Peach:

1. E3, C1

Mauve:

1. H37, H35

Mustard:

1. C9, E9

Indigo:

1. I30, G31

Baby pink:

1. C37, C35

Baby blue:

1. B26, C30

Sky blue:1. C29(2)

The remaining colors were only listed by one participant. Their prototype chip is presented along with the color term.

Charcoal: I
Bronze: F7
Tan: B10
Blood orange: H5
Sage: C16
Terracotta: G6
Crimson H1
Apricot C6
Plum I36
Fuchsia F40
Khaki E8
Cerise: F39
Coral: F2
Vanilla: B8
Amber: G8
Emerald green: H15
Chesnut: I7
Cerulean blue: I29
Midnight blue: I27
Dusty pink: C36
Rose: I40
Aquamarine: D23
Off-white: B15
Salmon: B5
Eggshell: B1

Appendix F

Chips selected as prototypes for chips listed by less than half of Swedish participants.

The chips are presented in order of frequency and the number of participants who selected it as the prototype can be seen in parenthesis. The chips without a number in parenthesis were selected by only one participant.

Turkos:

1. E25, D23, D28, F3, D20, E22, D21, D24

Violett:

1. G33, G34, H34, E27, F36, F37, F35

Beige:

1. B7, G10, C1, C6, C5, C7

Vinröd:

1. I3(3)
2. I2, I1, I4

Silver:

1. D(4)
2. B(2)

Marinblå:

1. I30(4)
2. H30

Guld:

1. C9(2)
2. F10, F9, F8

Cerise:

1. F40, F1, H40, G37

Gredelin:

1. G33, D35, G34, F33

Magenta:

1. F1(2)
2. F37, E1

Kolsvart:

1. J(3)

Purpur:

1. I39, H36, G40

Brons:

1. G10, F7, E7

Skogsgrön:

1. H15, D12, I15

Plommon:

1. I39, I34, I37

Himmelsblå:

1. H30, E30, C29

Brandgul:

1. E4(2)

Azur:

1. F26, G30

Petroleum:

1. I27, I28

Smaragdgrön:

1. G17, H16

Lime:

1. D15, D14

Mossgrön:

1. G16. H16

Militärgrön:

1. H14, H9

Indigo:

1. G32, E31

Aprikos:

1. D5, C7

Okra:

1. F6, F7

Lavender/l:

1. E32, D33

Cyan:

1. C18, F29

The remaining colors were only listed by one participant. Their prototype chip is presented along with the color term.

Koppar: E6
Barrgrön: I17
Blodröd: I4
Havsblå: I28
Snövit: A
Senapsgul: C9
Krom: C
Pissgul: E9
Kornblå: E28
Rapsgul: C9
Gammelrosa: C40
Bärnsten: G6
Kastanjebrun: G6
Midnattsblå: I29
Mauve: C35
Korall: D4
Mintgrön: C18
Hudfärg: C7
Vaniljvit: B8

Kritvit: A
Babyrosa: B40
Babyblå: C29
Citrongul: C9
Scharlakansröd: F4
Kobolt: G29
Antracit: I
Gråmetallic: F

Appendix G

Link to download zip files of all the data used in this thesis:
https://osf.io/9k4qd/?view_only=865dbc97846d4efaae49252e028e54cd

The link will take you to Open Science Framework (OSF). Under the tab ‘Files’ you can find two folders, one with the results of the survey, free elicitation task, and the prototype task and one with the results of the boundary task. Both folders are divided into English and Swedish.