Public's Visual Preferences Survey Facilitates Community-Based Design and Color Standards Creation

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Public's Visual Preferences Survey Facilitates Community-Based Design and Color Standards Creation

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Abstract: According to research, there is a disparity in the aesthetic design preferences of the public and architects. This is especially noticeable in urban areas environments, where there is a wide range of demographic variables and a lack of active public involvement in decision-making. The study included a visual preference survey to evaluate the perception and ranking of two dominant color schemes in local development projects in Stockholm across different age, ethnicity, and gender groups from Sweden. Over 400 people participated in the survey, which used photo-elicitation and a literature review. The objective was to determine the extent of divergence and disparities in the ranking of color schemes. The first dominant color schemes are a group of four analogous colors related to the Natural Color System's (NSC's) basic colors. The second is a group of four neutral colors that are related to grayscale colors. The study demonstrates that one could also measure building color schemes using visual preference ranking. Moreover, the research introduced a unique method for city planners to understand diverse ethnic, gender, and age group perceptions of color schemes in current projects, promoting active participation in decision-making and providing valuable insights. These insights can enhance people's sense of belonging, a prerequisite for social sustainability, and improve the quality and profitability of future projects.

Keywords: visual preference survey; color schemes; photo-elicitation; social sustainability

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1. Introduction

Research on urban planning suggests that when designing cities for social sustainability, we must consider all diverse groups in society. Sustainable urban engagement is necessary for healthy communities to thrive. It is necessary to involve the residents of these areas in the creation of spaces that promote well-being and a sense of community [1]. According to [2], we may build sustainable, prosperous environments that promote well-being by learning what people need from their homes and workplaces. Involving the community in the decision-making process is an integral part of environmental and social impact assessment (EIA and SIA) in developed countries [3]. However, this is not the case on most developing projects since we see that the separation between the public and design professionals is widening in a number of large-scale projects where customers and users hold divergent views and the designer seldom communicates with the end users [4]. Specifically, in terms of the aesthetic or visual elements of design, designers often attempt to impose their own preferences on users (clients) or, at most, believe that consumers would share their preferences [5]. In a similar way, conventional architectural practice usually undervalues the expertise of the user and denies their involvement in decision-making [6]. One of the primary responses that is elicited by the built environment is the emotional response to its visual aspect [7] since humans are in constant interaction with

their immediate environment in their daily activities and lives [4,8]. The aesthetic reaction to buildings arises from a continuous interaction between engaged individuals and their surroundings [4,8] contends that we often dismiss aesthetic properties as too subjective. Recent developments in neuroscience, environmental psychology, and other fields have given new relevance to the topic. Happiness and life satisfaction can be influenced by the visual appearance of the built environment, which contributes to affective responses and psychological affect [9–16]. However, the visual appearance of the built environment does not always suit the public's preferences. According to [4], new buildings and changes to existing buildings affect the quality of the streetscape, and design professionals and others involved in both large-scale and small-scale new construction and renovation create public eyesores. Gans [17] acknowledges the ongoing documentation of aesthetic flaws in large-scale architectural projects. Evidence from studies by [18–22] suggests that public and architect preferences differ. For instance, Devlin et al. [19] conducted research in 1989 where they rated 40 houses designed by architects and other experts. Interestingly, the architects favored designs that the other professionals did not, and vice versa. These facts point to weak emotional responses and participation in the planning process.

As a visual quality of design in the built environment, color elicits a powerful aesthetic response because it plays a significant role in urban fabric and architecture, enhancing building façades and giving communities character; moreover, it creates a sense of well-being and originality in architecture [23]. Indeed, colors are a fundamental aspect of our perception of the environment. As such, they can serve as information, communication, and design material [24] and may facilitate many functions of daily life [24,25].

Literature has shown that colors also have a strong impact on the emotions and feelings of individuals [26–31]. In other words, color, a subtle stimulant with a salient impact, profoundly influences human lives on a physical, psychological, physiological, and sociological level every day and has gained widespread acceptance [32]. This is because there is a strong correlation between the human mind and color as a physical phenomenon [33]. Color therapy, or chromotherapy, has developed around the belief that colors have specific therapeutic properties for the mind and body [34]. Visual experiences create meanings and feelings [35]. Our brain attempts to memorize color schemes and assign meaning to each color through an association process, resulting in a subjective color culture or color tradition. Every incoming image finds a relative source in memory, which also charges it with meaning and defines its subsequent treatment [36]. According to [37], there are no "good" or "bad" colors, as all colors have positive and negative effects depending on context and evoke responses tempered by viewers' experiences. The accumulation of visual experiences leads to the formulation of a subjective color tradition, similar to how language, music, and food differ across cultures. Hiler [38] ascribes psychological significance to each color. Peterson et al. [39] assert that a single color can hold diverse meanings across different cultures. Understanding color preferences gives insight into the role of color in guiding the observers' interaction with their visual environment [40]. While particular colors have been found to be highly preferred regardless of age, racial group, or culture [41,42], there is some evidence that color preference may be culturally based [27]. In a comparison of Japanese and Korean subjects, Saito [43] found unique color preference tendencies between the two countries, as well as age, gender, and geographical region within the individual country [26]. Man's color perception and discrimination vary in varying lighting conditions. However, certain differences in the use of color by different cultures may have an ecological basis [44]. Recent research revealed a systematic relationship between color preferences and the affective response to environmental objects [45]; observers typically favor colors associated with objects they find more appealing [40,46]. Silver et al [47] study confirms the observation that males are significantly more likely than females to prefer variations on the color blue [48].

Gage [33] argues that the aesthetics of color have developed little due to its focus on laboratory testing and not on practical color preferences. However, the difficulty in quantifying sensations has led to a lack of comprehensive understanding of color [33]. This

lack of understanding also contributes to the disparity in color choices between Swedish residents and local project architects. Research and evidence suggest that design guidelines, such as design standards, aim to regulate individual behavior for the benefit of society and consider practical solutions to address this disparity. Design guidelines and standards provide practical, popular, and legal grounds for shaping the design of public places to enhance their enjoyment. Designers, policymakers, and the public agree on the importance of controlling building appearance [4]. To succeed in this goal, design controls, whether discretionary or administrative, must be based on appropriate guidelines derived from research [4]. According to conventional wisdom, the variability in preferences across time and individuals precludes the development of such guidelines. However, research has repeatedly confirmed commonalities in architectural preferences [22,49,50]. Research-based guidelines should form the basis of all design controls since they are objective and useful tools for improving building and streetscape color experiences. Prior to initiating the main research, the authors conducted a study to evaluate the previous consideration of color schemes in global-local development projects, aiming to ascertain the appropriate application of predetermined guidelines or standards. The study examines color guidelines and standards for new developments in Stockholm, particularly in the Barkarbystaden, a district in Järfälla municipality, and five U.S. cities: Fremont, Chestermere, Seattle, and Livermore, California. The research reveals that previous design requirements do not give enough consideration to color schemes, and there are no predetermined guidelines or standards for architects to use. (Please refer to Appendix E.) Instead, the absence of standards allows for subjective design choices, enabling architects to select colors that may not suit the general public's taste or preference. The findings support the research objectives to develop research-based color standards that consider the preferences of Swedish social groups for local development projects in Stockholm. This research aims to close the gap in creating more cohesive communities by giving the public more control over color scheme selection in upcoming development projects.

This research focuses on the color schemes used in architecture and streetscapes, particularly emphasizing the local colors found in Stockholm, especially in high-rise apartments. The colors of landscapes, houses, clothes, and traditional crafts help shape general impressions of Stockholm's color palette. However, due to their significant correlation with time and geography, historical investigation is necessary to determine the preferred colors among Swedes.

This paper engages with sociodemographic diversity through an inclusive process with a Swedish-scale group, using a visual preference survey technique.

The aim:

This study examines the differences in color choices between Swedish residents and local project architects. In addition to promoting active participation in decision-making and creating research-based color guidelines for local projects in Sweden based on the preferences of different age, ethnicity, and gender groups in Sweden, this paper aims to help city planners and architects gain valuable insights into the diverse sociodemographic perceptions of color schemes in built projects.

The objectives are:

Examine Swedish residents' color preferences for local projects in Stockholm using an inclusive survey method that encompasses different age, ethnicity, and gender groups in Sweden.

Create research-based color guidelines for local projects in Sweden based on the preferences of different age, ethnicity, and gender groups in Sweden.

Promote active participation in decision-making to enhance people's sense of belonging, a prerequisite for social sustainability.

2. Literature Review

2.1. Visual Preference Surveys (VPS^{TM})

Conducting public visual preference surveys (VPS^{TM}) is one way to evaluate and rate potential design and planning feature options. VPS^{TM} are a valuable tool for urban planners and designers to gather public opinion on potential designs for developments and the redevelopment of existing sites [37]. VPS^{TM} help citizens and community leaders envision design alternatives in ways that words, maps, and other communication media cannot. This makes them ideal for "visioning" projects, design charrettes, and other physical planning activities with public involvement [51]. Researchers can rank alternative solutions to design and planning features by conducting a VPS^{TM} in a public setting. People often choose images to elicit expected responses. Participants will rank an image with a feature they prefer highly and an image with a feature they dislike poorly. As a result, planners and architects can develop the best alternatives to improve the visual quality of the environment. Compared to other methods of communication, such as verbal descriptions or maps, this type of survey allows community leaders and citizens to better visualize the design options [4].

We need to take into account that, in most cases, we evaluate the built environment in terms of its visual quality, which is the aspect that makes better cities and urban spaces [52]. In fact, evaluation is central to our perception of and reaction to the environment [53–56]. The visual quality of the environment is also a major concern for the public [56]. Focusing on visual quality is an attempt to understand the importance and impact of the built environment on people's quality of life, facilitating further discussion in the fields of architecture, planning, urban design, and environmental psychology [52]. However, visual imagery has received very little attention in environmental behavior research [6]. By expanding the visual information base, we can understand more about the form, action, and interpretations given to environmental settings. Paying attention to the inside and outside appearance of the environment can greatly enhance our understanding of social activity [6].

The VPS^{TM} proved to be a valuable technique in the 1980s, informing the public of alternative design options and collecting data on the public's relative preferences for the different options [57]. A focus on visual information as a medium for communication can expand the dialogue between researchers and respondents, between researchers and designers, and between designers and clients [6].

Indeed, developers are constantly developing the latest tools to assess a project's impact and harness stakeholders' creativity. State-of-the-art tools and technologies, such as VPS^{TM} and computer-assisted design programs that can illustrate a proposed project in its setting, have enabled developers to create interactive, virtual models of proposed plans. Such tools can help developers create design elements that benefit both the community and the project [4].

In this research, through VPS^{TM}, the study intends to evaluate the perception and ranking of two dominant color schemes in local development projects in Stockholm across different age, ethnicity, and gender groups in Sweden.

The following are some relevant studies: The effort to redesign suburban America has garnered national attention for VPS™, as surveys conducted by "New Urbanist" planners reveal consumers' preference for traditional small-town and village vistas over modern suburban scenery. As a result, local development regulations and procedures have evolved [4].

Prior to their use by New Urbanists, VPS^{TM} techniques were employed as research instruments by forest managers, environmental psychologists, and landscape architects. These professionals initially applied survey methods to wildlands, urban parks, urban landscapes, and specific urban design elements like signage and parking. The parameters within which visual preference studies operate are well defined by decades of experience, which guided the study's conduct [4].

Appleyard (1976) reported research in Ciudad Guyana that assessed connotative meanings. He obtained respondents' opinions about the attractive and ugly parts of a

road, the reasons for these opinions, and public evaluations of several buildings [56]. Gould mapped evaluative responses on a national and international scale. From interviews about preferences for states in the United States, he constructed evaluative maps of the nation [56]. Another study investigated the relationship between people's impressions of the amount of detail in architectural façades and the design features of trim, ornaments, and materials [58]. A similar study examined mass impressions [58]. Krampen [59] investigated the relationship between subjective and objective measurements of complexity for façades of tenement buildings, using a method similar to the study of architectural detail [58]. Additionally, Elsheshtawy [60] reported on another study of the complexity of architectural façades.

2.2. Photo-Elicitation

Urban environments can be shown to participants in a number of different ways, and they can then rate how they perceive the surroundings and how they feel about them. An extensive list of possible formats for a literature review is given by [61]. Images, 3D models, virtual reality tours, color films, and actual site visits all fall under this category. Because of their differences in realism and the amount of control they give during experiments, each of these modes has advantages and disadvantages. Photo-elicitation is a highly effective method that involves the use of photographs during research interviews. By incorporating a photograph into the interview process, valuable insights and information can be obtained. Participants are shown a collection of pictures and asked to select a subset that best captures a certain topic or situation [62]. It is quite common practice in several branches of the social sciences to utilize images as interview mediators during one-on-one interviews [62]. As Van Auken et al. [63] stated, this method has the ability to give people more power to take part in activities related to local planning for long-term development of communities and natural resource management. Photo-elicitation may overcome the difficulties posed by in-depth interviewing because it is anchored in an image that is understood, at least in part, by both parties [64]. In photo-elicitation, there are mainly two primary types. The first is participant-driven photo-elicitation, a process in which participant photos are paired with in-depth interviews [63]. The second one is driven from the outside; people are asked to rate pictures that experts have already chosen [63]. Beilin [65] says that environmental studies that use this version "have tended to include providing a set of photographs that are shown to all respondents." People could be asked to give their opinions on different land-use scenarios shown in photographs [66] or computer-made pictures A lot of planning has used these kinds of methods, most notably through VPS^{TM} [67,68]. However, this method has also been criticized in the field of academic study. Stewart [69] state that when the researcher, planner, or expert controls the stimuli, it leads to a top-down and closed-ended method. Because of this, there are doubts about its ability to handle worries about representation. Crisman and Stewart [67,69] disagree on whether the data it generates is accurate. No matter how familiar an object or situation is, a photograph is a restatement of reality. It shows life in new, objective, and arresting ways and can make the person talk about it as if they were seeing it for the first time [70]. If pictures help people understand their world better, then using pictures to make people think would be a natural step forward in social science study and public planning [63]. Others, like [63–65,69,71], stress how images can show events, social areas, and physical places. The difference between interviews using images and text and interviews using words alone lies in the ways respondents engage with these two forms of symbolic representation. This has a physical basis: the parts of the brain that process visual information are evolutionarily older than the parts that process verbal information [64]. According to [62], one option is to make a poster out of the stimulus photos and have people write their thoughts on it or around it. You may utilize typical quantitative approaches to examine frequencies and have the information shown as bar charts or pie charts [62]. This could be useful if you're interested in which photos get picked most often [62] (Figure 1).

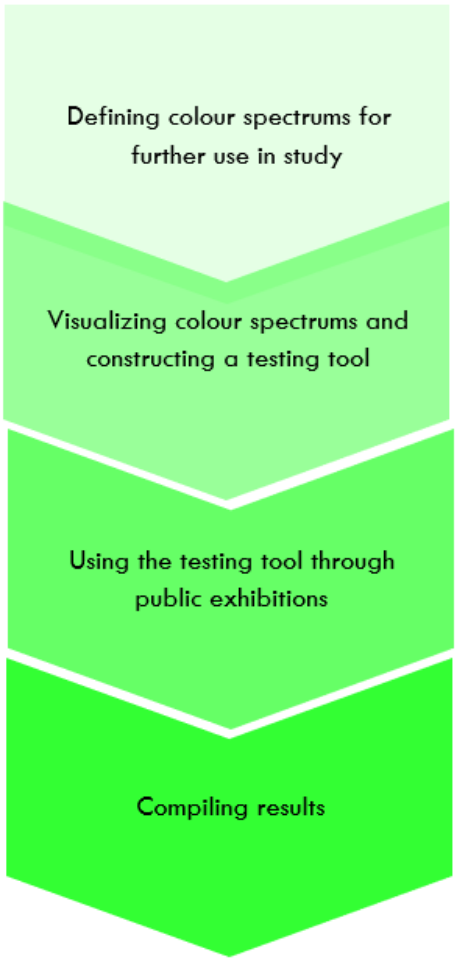


Figure 1. Simplified flow chart of the study.

3. Methods

3.1. Step 1: Identifying Color Spectrums for Future Use in the Study

We defined the color spectrums for the study using historical and contemporary color profiles from Swedish architecture and streetscapes. In Step 1, we will define the colors within the context of the built environment. The colors will be defined through a historical review of the literature and a survey of the color schemes of Swedish buildings and streetscapes after 2000.

3.1.1. Recent and Historical Color Profiles of Sweden

One way to place color in a broader perspective is to look at its history [33]. In our research, we have traced some strands in the history of color. Specifically, we are researching color schemes used on building façades that have become part of Stockholm's aesthetic scene. The term "color tradition and culture" refers to color schemes that are deeply rooted and popular within the city's culture. Architecture and the urban environment are cornerstones of any tradition, revealing much about the built environment's history and roots. What materials did the builders use to construct the buildings? Which colors did they use to paint the various buildings?

3.1.2. A Historical Review of the Color Schemes of Traditional Swedish Buildings from 1700–1800

Concerning the color schemes of traditional Swedish buildings from 1700–1800, the book *Så byggdes Staden* presents eight samples of residential buildings, as shown in Appendix A. Björk et al. [72] selected 8 building samples from a total of 25 landscapes, specif-

ically from the following regions: Dalsland, Gotland, Skåne, Blekinge, Ångermanland, Värmland, Östergötland, and Gästrikland. We studied these samples, focusing on paints and color schemes.

To present our findings regarding color schemes, we used some materials and illustrations from the book Så byggdes Staden by [72]. Using Adobe's color program, we analyzed the eight building samples shown in the book to scientifically identify the traditional color schemes. This program enabled us to communicate our results in an easy-to-understand way.

3.1.3. B: A Historical Review of the Color Schemes of Traditional Swedish Buildings from 1800–2000

The book Så byggdes Staden presents nine examples of different building styles, as detailed in Appendix B. The period from 1800–2000 saw the emergence of dominant styles. Björk, Reppen et al. [72] identified nine distinct styles. These styles are:

- Style 1800–1880 century
- Style 1880 century
- Style 1950 grannskap
- Style 1960 record-year
- Style 1970 big mass building
- Style 1980 districts city
- Style 1990 mixing styles
- Style 2000 new modernism

3.1.4. C: A Current Survey on the Color Schemes of Swedish Buildings after 2000

Since 2000, local development projects have painted buildings in different color schemes, resulting in diverse streetscapes. Nearly all new developments in Stockholm municipalities were photographed to scan buildings built after 2000. We took 4000 photos across various municipalities to evaluate the colors used in Stockholm. Most of the photos were taken between 2016 and 2017. The majority of the images were self-acquired by researchers, while the authors obtained the remaining images from the websites of building companies. Two color schemes dominated this scan:

1. An analogous group of four colors corresponding to NCS's basic colors, as depicted in Appendix C.
2. A group of four neutral colors related to gray scale, as depicted in Appendix D.

3.2. Step 2: Visualizing Color Spectrums and Constructing a Testing Tool

Step 2 involved visualizing the color spectrums defined in Step 1. The findings from the literature review, along with 4000 photographs taken by researchers or retrieved from building companies' websites, guided this step. Out of these 4000 photographs, which represent the color schemes of local development projects in Stockholm, the authors selected 16–20 photographs for each poster.

This paper's photographs showcase two of Stockholm's most prominent color schemes, which we discussed in Step 1. As previously stated, there are two color schemes:

An analogous group of four colors corresponding to NCS's basic colors, as shown in Appendix C.

A group of four neutral colors related to gray scale, as shown in Appendix D.

In order to provide more possibilities for participants, we have introduced a fifth choice for each of these two color schemes. This allows participants to reject all the options and instead select a combination of all colors.

3.3. Step 3: Public Exhibitions and Testing the Tool

For the survey, we utilized public exhibitions, individual surveys, and group surveys to gather respondents. Two visual sets, each consisting of one poster and seven folders, represented two distinct color schemes. The first set included four analogous colors associated

with NCS basic colors, while the second set included four neutral colors associated with grayscales. The posters in the sets measured 1 m by 2 m each, and the folders were in A3 format. The second set had 20 photos, while the first had 16. (Refer to Figure 2).

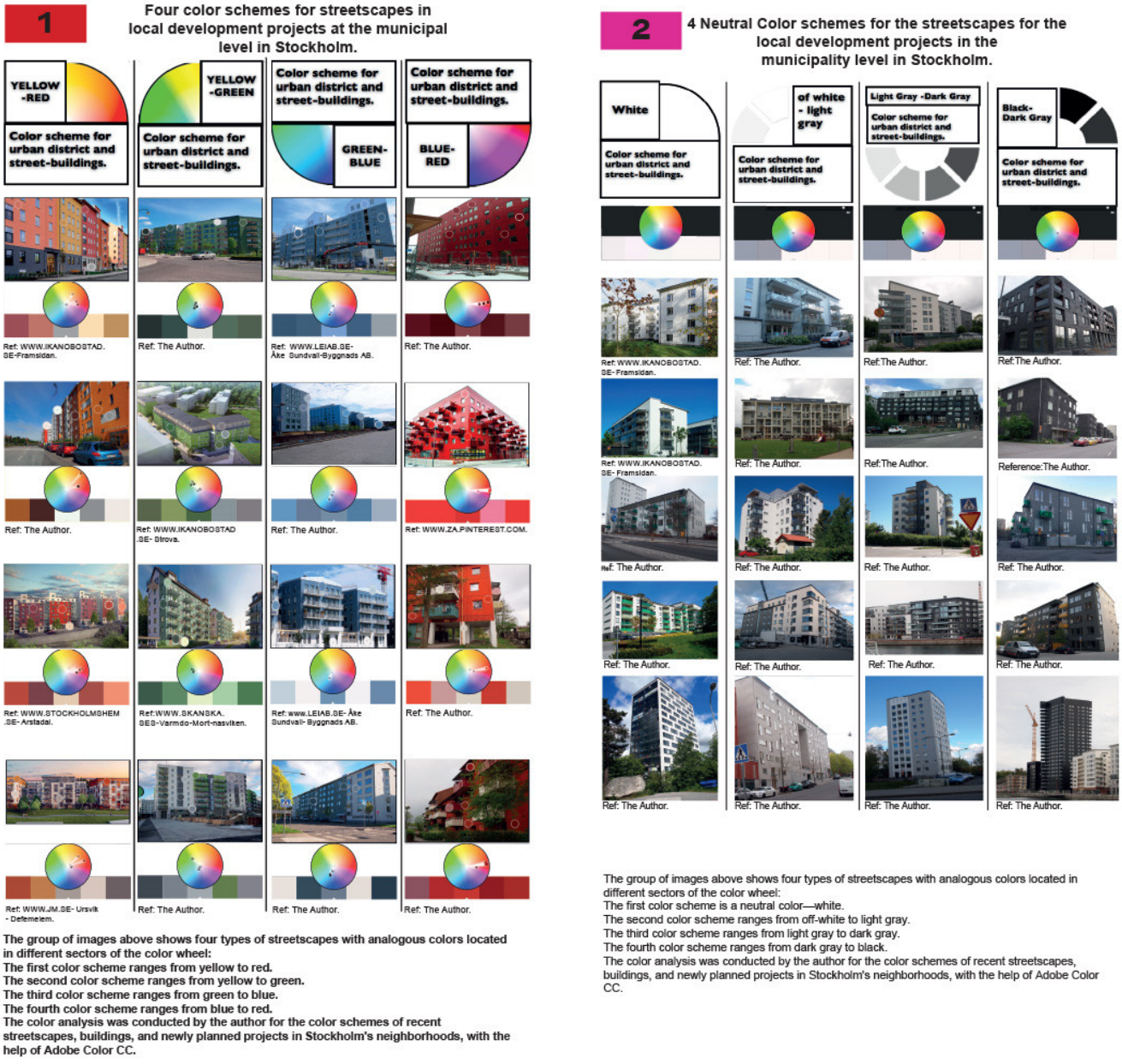


Figure 2. The figure displays two posters. A poster with four NCS basic colors is on the left. The right poster has four grayscale-related neutral colors. The authors created this.

The authors conducted a VPS^{TM} and used photo-elicitation to process these two visual sets thoroughly. In total, 414 individuals responded to the first set, while 426 responded to the second. To enhance citizen engagement in the survey, the authors added an explanatory text to the poster. (Refer to Figure 3).

These two sets were displayed in various surveys with different types of Swedish groups and individuals, as well as in six universities in five Swedish cities, provided the majority of the data. These six universities are located in Stockholm, Västerås, Karlstad, Växjö, and Jönköping. The sample groups of respondents represented, to a large extent, a real portion of Swedish society. The survey sample included individuals aged 18–25, 25–30, 30–40, 40–50, 50–60, 60–70, 70–80, and 80–90.

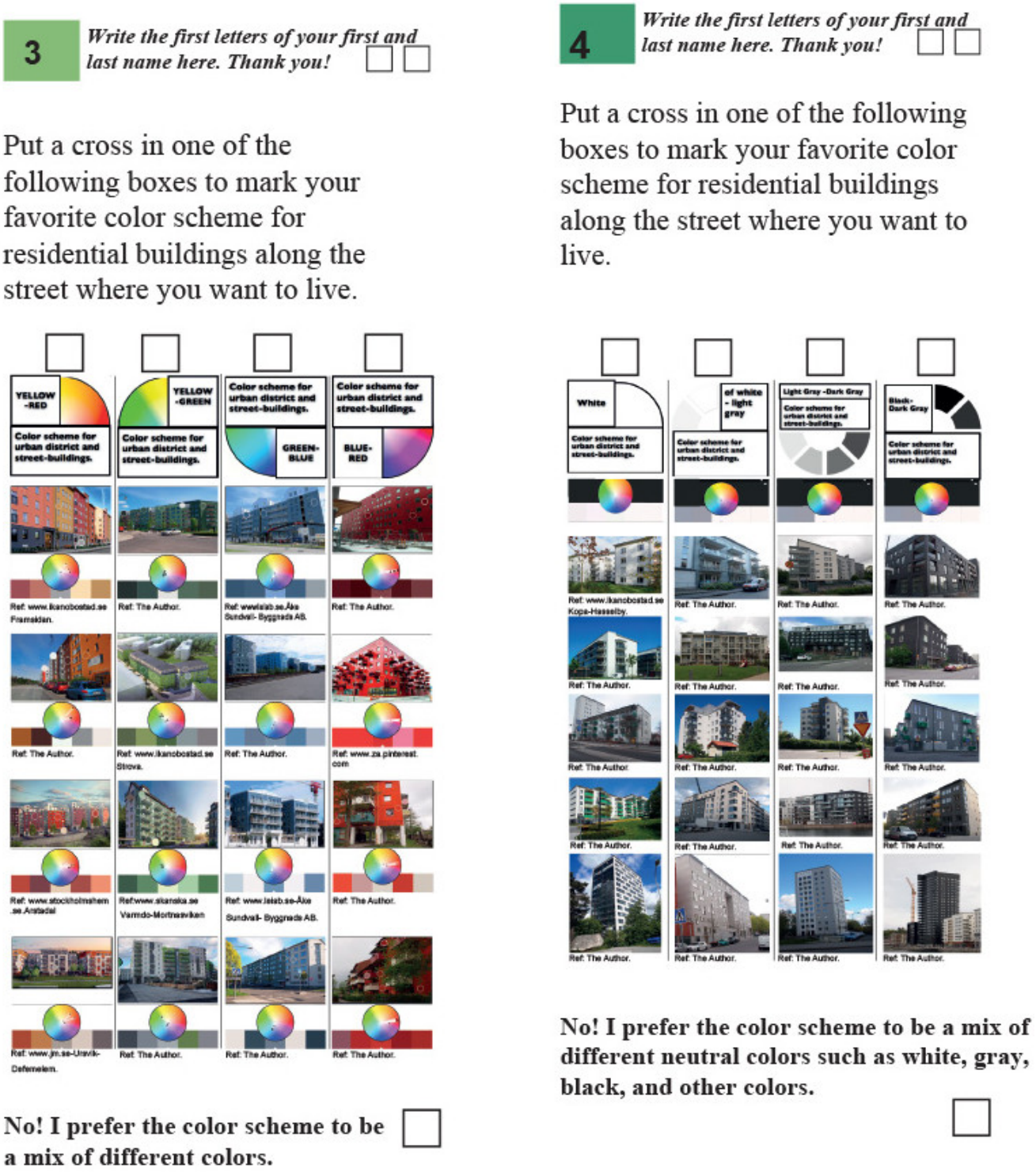


Figure 3. The figure displays two posters. On the left, a poster has four basic NCS colors. The poster on the right has four grayscale-related color schemes. Both posters now have exploratory text. The authors created this.

A study conducted by (Sorokowski, Sorokowska, and Witzel 2014) showed that color preferences change during the course of the adult life span. Therefore, studies dealing with color preferences in adults should consider the age distribution of the subjects under study.

The survey received responses from four ethnic profiles. The profiles included a Swedish male, a Swedish female, a non-Swedish male, and a non-Swedish female. (Please refer to Table 1).

Table 1. The types, numbers, and percentage of respondents with regards to age, gender, and ethnicity.

Profiles		Age Categories and Participants' Number							Total Numbers of Participants (Gender and Ethnicity)	Percentage of the Total Number
		18–25	**25–30**	**30–40**	**40–50**	**50–60**	**60–70**	**70–80**		
The gender and ethnicity of individuals who vote for colorful posters and folders	**Swedish male**	**57**	31	13	12	6	2	6	127	30.6%
	Swedish female	54	13	17	4	6	4	0	98	23.6%
	Non-Swedish male	36	29	20	5	5	9	2	106	25.6%
	Non-Swedish female	45	16	13	4	3	1	1	83	20%
Total numbers of individuals' gender and ethnicity who vote for colorful posters and folders		192	89	63	25	20	16	9	Total number 414	
The percentage		46.3%	21.4%	15.2%	6%	4.8%	3.9%	2.2%		
The gender and ethnicity of individuals who vote for neutral-color posters and folders	Swedish male	60	34	12	12	6	2	4	130	30.6%
	Swedish female	58	13	17	4	6	4	0	102	24%
	Non-Swedish male	33	34	18	6	5	9	2	107	25.2%
	Non-Swedish female	46	18	12	4	3	1	1	85	20%
Total numbers of individuals' gender and ethnicity who vote for neutral-color posters and folders		197	108	49	26	20	16	7	Total number 424	
The percentage		46.4%	25.4%	11.6%	6.1%	4.7%	3.8%	1.7%		

3.4. Step 4 Compiling Results

3.4.1. Results of Step 1

We compiled the survey results and drew our conclusions. We discussed the results of the historical review on the color schemes of traditional Swedish buildings during the three periods: 1700–1800, 1800–2000, and after 2000.

A. The historical review revealed the color schemes of traditional Swedish buildings from 1700–1800. A historical analysis of eight buildings reveals that traditional construction materials were local, with timber and stone being the primary materials. Timber panels covered three samples, while two samples were left uncovered. The timber construction was often covered with lime. The 1700s saw the first painted façades on timber buildings, with sludge or linseed oil applied to the outdoor wood surfaces. We used Adobe Color Analysis to analyze the color scheme, revealing a secondary color of green or light green on some buildings' roofs or entrances.
B. The historical review revealed the color schemes of traditional Swedish buildings from 1800–2000. This research uses color analysis to examine historical building styles based on various style samples from the book Så Byggdes Staden by Björk, Reppen, et al. (Björk, Reppen, and Nordling 2012). The analysis reveals that the colors of building façades before 1800 were yellow, grey, rose, and red. From the 1800s to the 1880s, the colors changed to yellow, grey, and pink. From the 1880s to the 2000s, the colors evolved to yellowish, grayish, light yellowish, and brownish. (Please refer to Figure 4) .
C. The current survey reveals the color schemes of Swedish buildings constructed after 2000.

An extensive investigation of the color schemes of Swedish buildings built after 2000 has identified eight group-dominating colors of streetscapes in Stockholm. The first four colors are analogous to the basic colors of the NCS, as seen in Figures 5–8. Second, there are four shades of gray that are associated with grayscale colors, as seen in Figures 9–12. The investigation also reveals the traditional Swedish color schemes found in the historic district of Stockholm. With a few exceptions, these color schemes primarily featured ochre colors, often paired with pale green or green as a secondary color. Please see Figure 13 for more information. Additionally, the study displays certain trends in the application of color to buildings as well as the distribution of color on building façades. Figures 14–18 illustrate the five observable tendencies that the authors have identified. Only a few cases show façades that interact with sunlight (mirror or reflectance effects), which are relatively rare. Where there is direct sunlight on the façade, the sun's interaction with the material creates a visually attractive effect and lightens the hue of the color selected. Transparent materials, such as fences and balconies, further enhance the façade by allowing light to enter and transforming the façade into a lighter version of the fence's color. This gives the façade an additional accent color that changes in line with the sun's position in the sky, as seen in Figure 19.

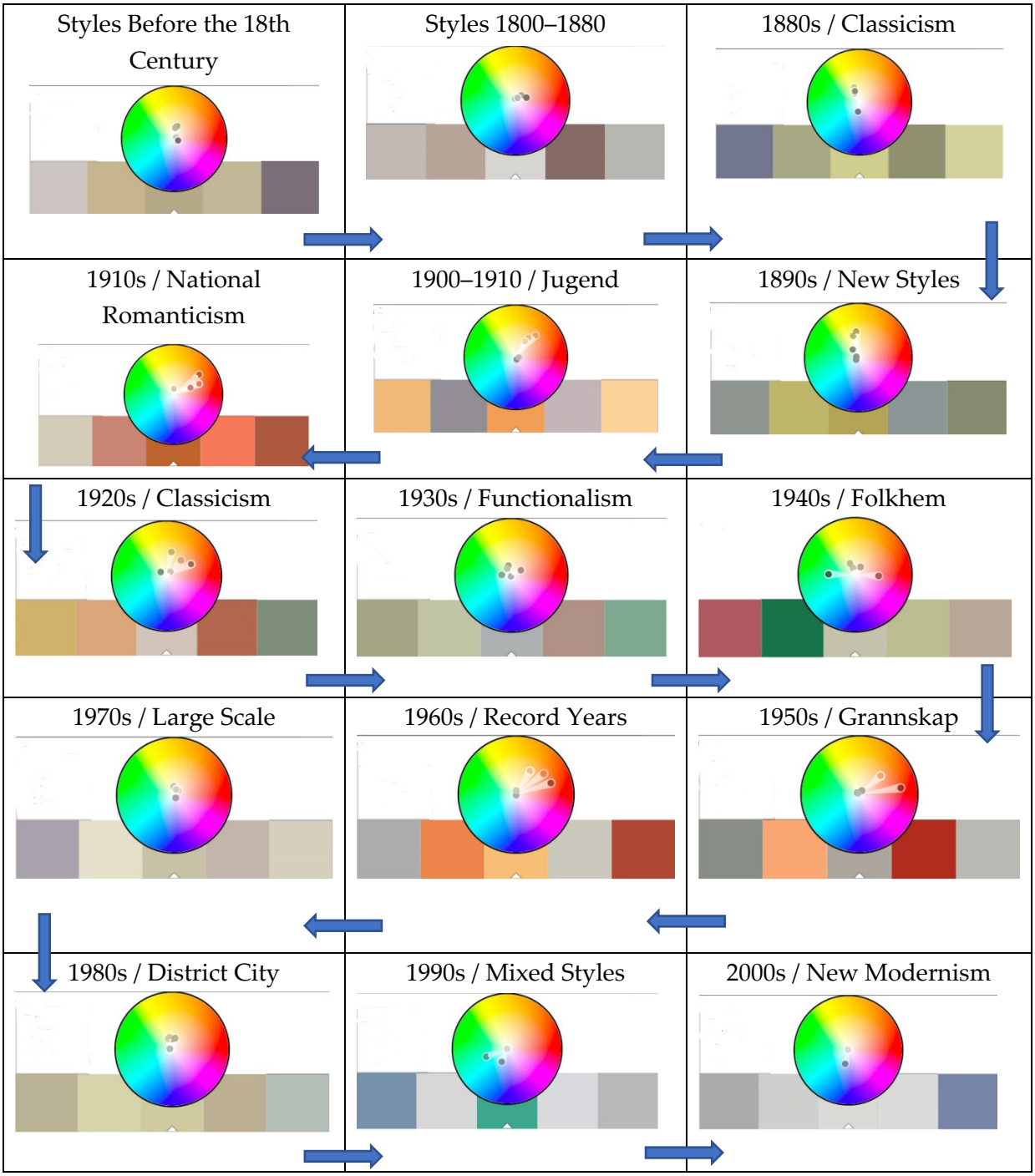


Figure 4. The figure schematically displays the results of a historical review of the color schemes of traditional Swedish buildings from 1800–2000. The author used Adobe Color CC (version 19) to analyze and visualize the colors. The authors created it.

Figure 5. Streetscape 1 shows a group of analogous colors located in the color wheel's sector that extends from yellow to red.

Figure 6. Streetscape 2 shows a group of analogous colors located in the color wheel's sector that extends from yellow to green.

Figure 7. Streetscape 1 shows a group of analogous colors located in the color wheel's sector that extends from green to blue.

Figure 8. Streetscape 4 shows a group of analogous colors located in the color wheel's sector that extends from blue to red.

Figure 9. Streetscape 5 shows a grouping of buildings with a particular white color, a chromatic color.

Figure 10. Streetscape 6 shows a group of buildings with colors ranging from off-white to a light-gray pure achromatic color.

Figure 11. Streetscape 7 shows a group of buildings with colors ranging from light gray to a dark-gray, pure achromatic color.

Figure 12. The historic location in Stockholm showcases the traditional colors of Sweden. Ochre colors were a common feature of these color schemes. Some examples combine ochre with green as a secondary color.

Figure 13. The figure displays a collection of monochromatic buildings, which are characterized by a single color or variations in hue intensity and value.

Figure 14. The figure depicts a cluster of buildings featuring a monochromatic façade, incorporating accent colors around the windows and balconies.

Figure 15. The figure shows a group of buildings with the same color scheme, complemented by accent colors applied to the windowsills, connecting walls, and balconies' fences.

Figure 16. The figure depicts a grouping of buildings that have a balanced weight and two dominant colors.

Figure 17. The figure depicts a group of buildings adorned with two polychromatic colors, with accent color patches randomly placed on their exteriors.

Figure 18. The figure depicts a collection of buildings featuring façades that interact with sunlight through mirror or reflectance effects. The interplay of the sun with the façade produces a striking effect and lightens the chosen color's hue on the façade where direct sunlight is present.

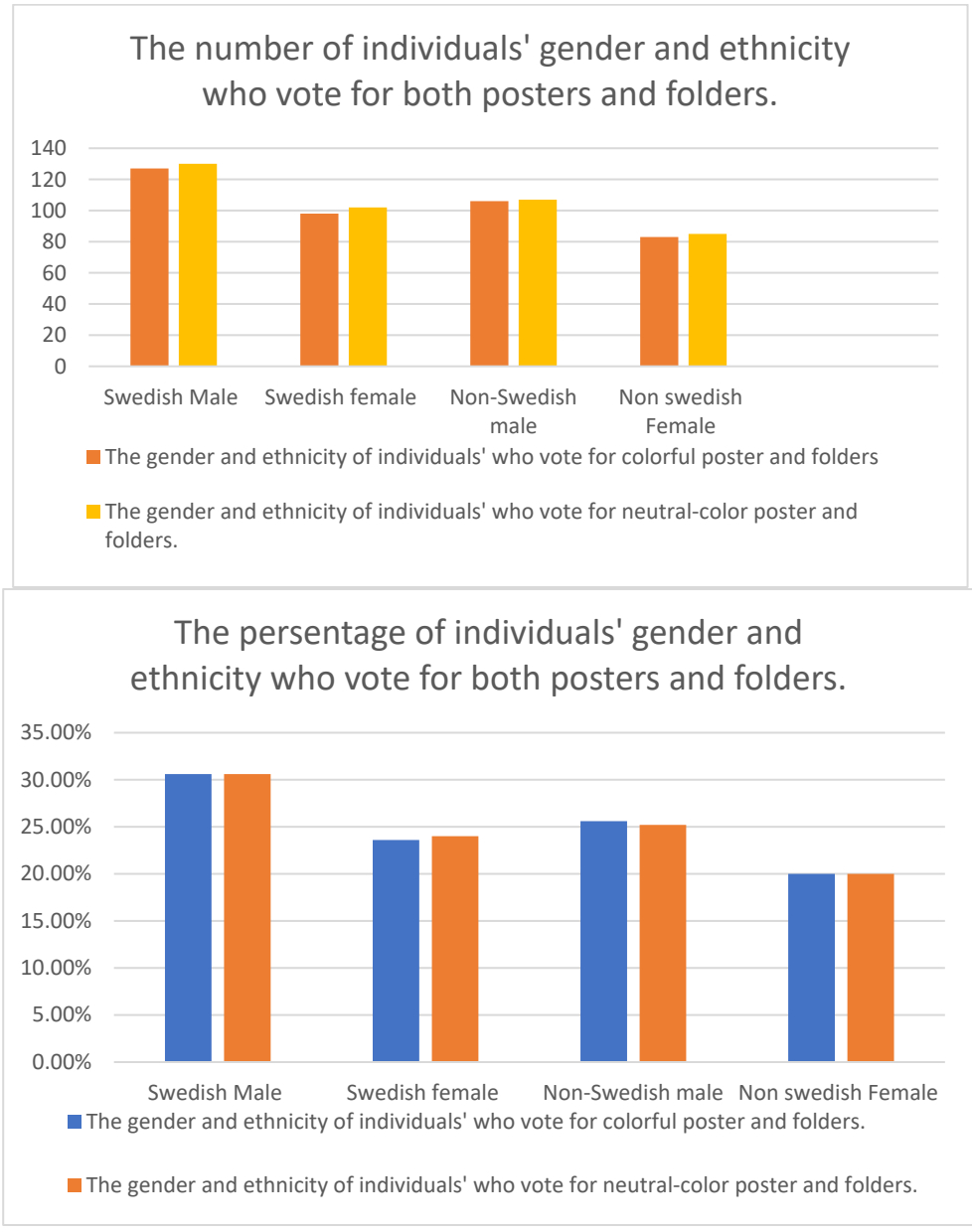
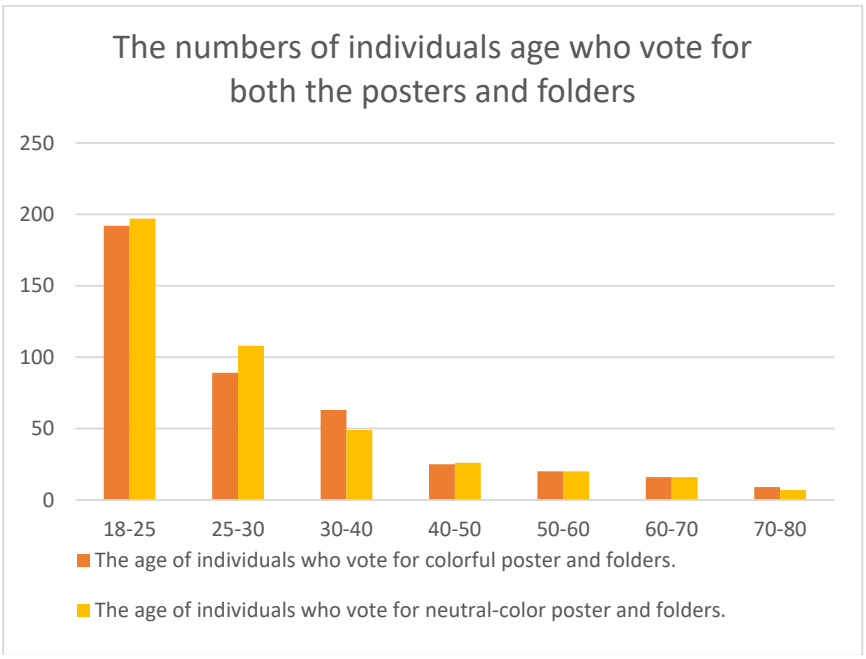


Figure 19. Number and percentage of respondents by gender and ethnicity who voted for both visual sets.

3.4.2. Results and Statistical Profiles of Step 3

As shown in Table 1, the results of the visual survey indicate that, out of 414 individuals who voted for the first color set, 46.3% were aged 18–25, followed by 21.4% aged 25–30, and 32.1% from other age categories. For the second neutral-color set, out of 424 individuals who voted, 46.4% were aged 18–25, followed by 25.4% aged 25–30, and 27.7% from other age categories. The results show that the gender and ethnicity of individuals who voted for both visual sets are similar in number. The majority of voters for both visual sets are Swedish males, while the fewest are non-Swedish females. The other categories fall in between (Figures 19 and 20).



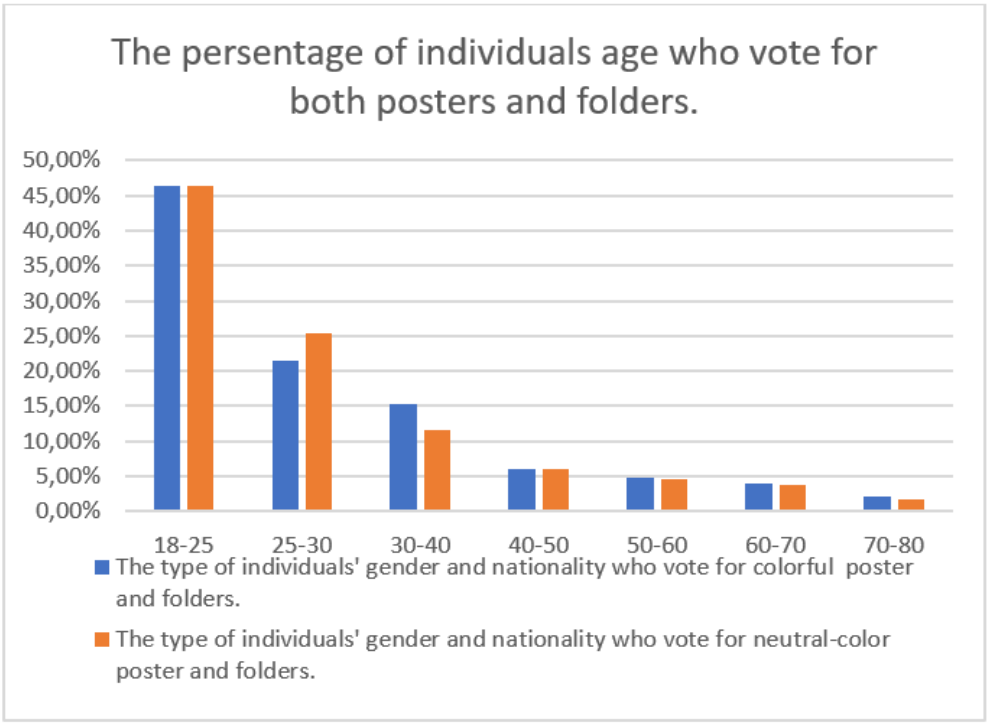


Figure 20. The figure shows the number and percentage of respondents by age who voted for both visual sets.

Analogous colors are associated with the basic NCS colors.

The results show that the yellow-red color spectrum is the most popular, while blue-green is the second most popular. This pattern holds across all investigated groups, except for non-Swedish males, where blue-green is the most popular, and yellow-red ranks second. Overall, blue-red is the least popular color option among all the groups examined (excluding the "different colors" option) (Figures 21–25).

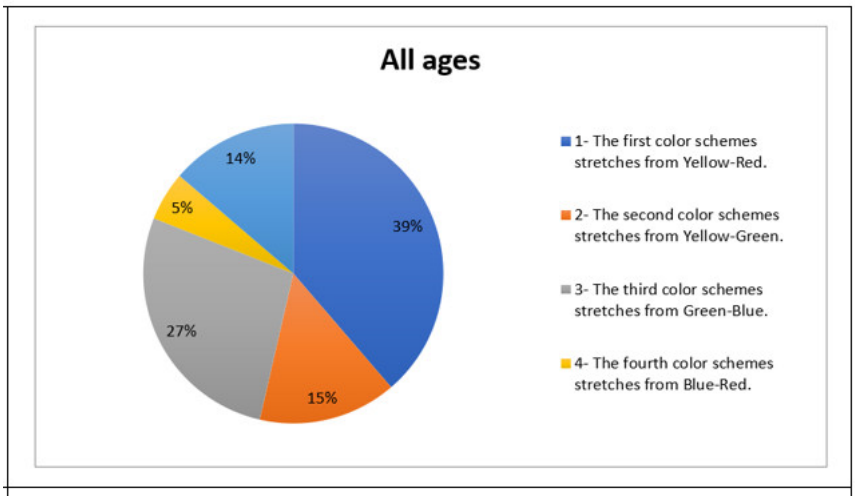


Figure 21. The overall results show that yellow-red is the most preferred color scheme.

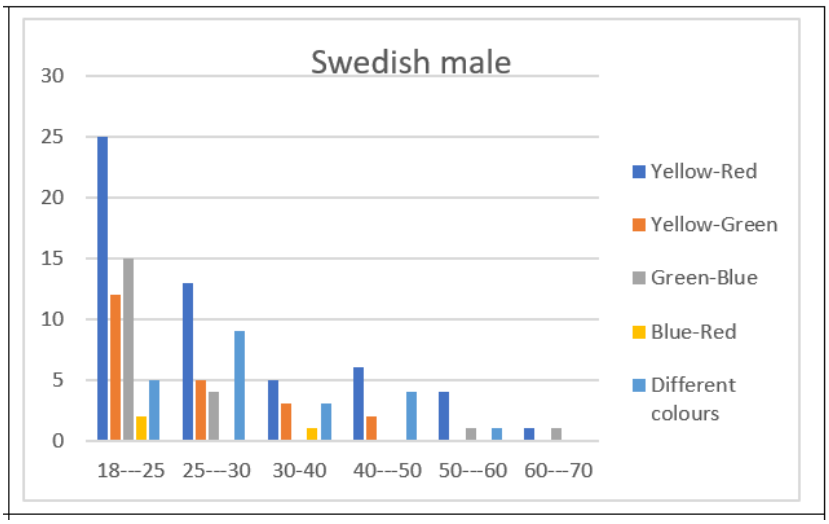


Figure 22. Swedish Male: In this category, yellow-red was the most popular color scheme. The green-blue color scheme was second most popular, and yellow-green was third most popular. Of the four "pre-chosen" alternatives, blue-red was the least popular.

Neutral colors associated with gray scales.

The results show that there is little disparity between the different color schemes, but dark grey-black is the most popular, with off-white-light grey coming in a close second. There appears to be a gender difference between these two options, as dark grey-black is most popular among all male categories, while off-white-light grey is most popular among all female categories (Figures 26–30).

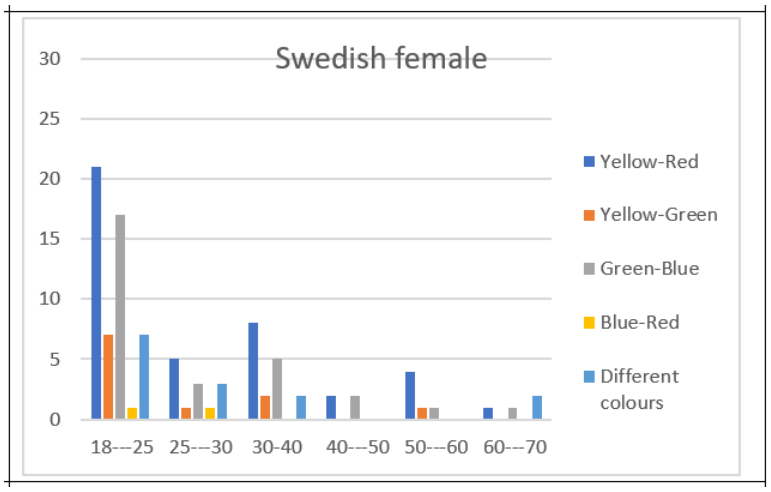


Figure 23. Swedish Female: In this category, yellow-red was the most popular color scheme. The green-blue color scheme was second most popular, and yellow-green was third most popular. Of the four "pre-chosen" alternatives, blue-red was the least popular.

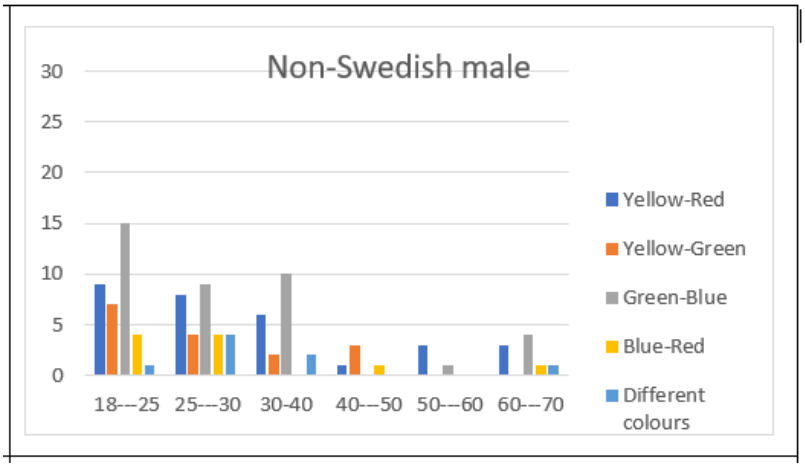


Figure 24. Non-Swedish Male: In this category, green-blue was the most popular color scheme, the yellow-red color scheme was second most popular, and yellow-green was third most popular. Of the four "pre-chosen" alternatives, blue-red was the least popular.

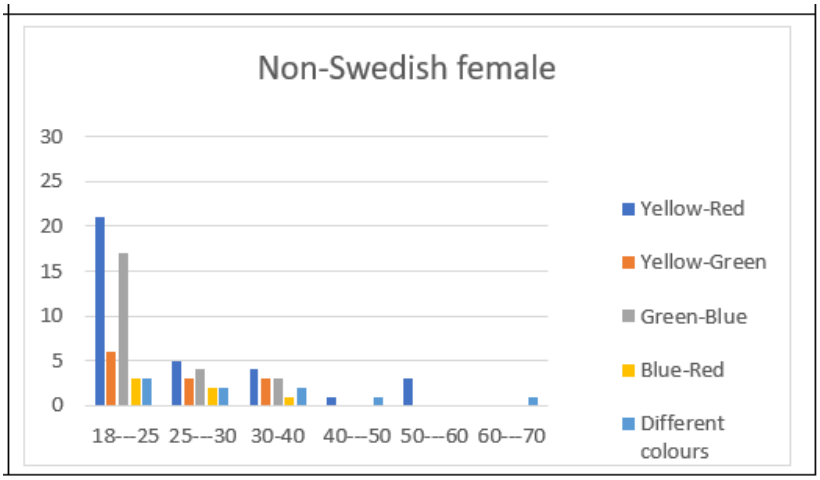


Figure 25. Non-Swedish Female: In this category, yellow-red was the most popular color scheme, the green-blue color scheme was second most popular, and yellow-green was third most popular. Of the four "pre-chosen" alternatives, blue-red was the least popular.

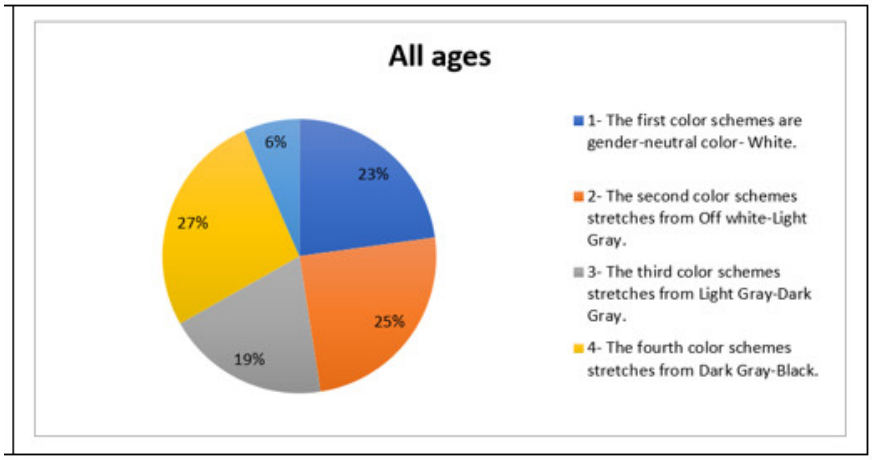


Figure 26. The overall results indicate that there is little disparity between the different neutral colors schemes, but the "dark gray-black" spectra are consistent and the most popular.

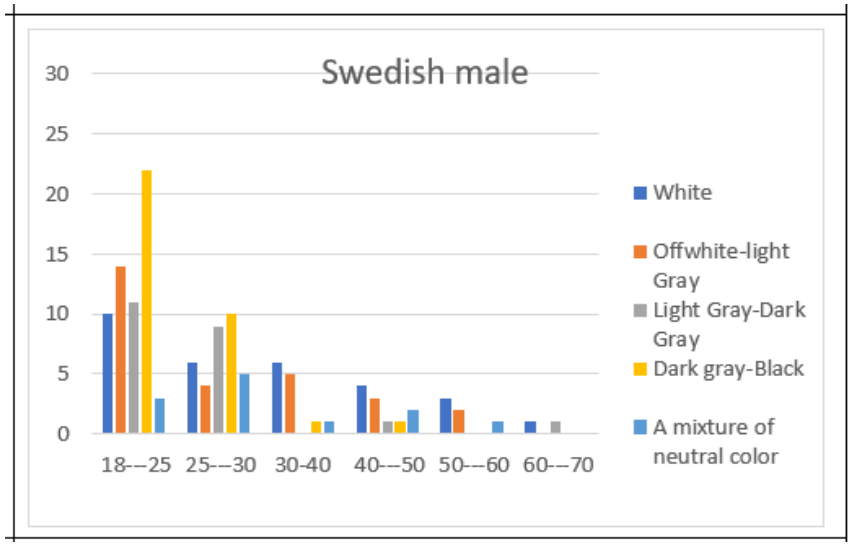


Figure 27. The results show that dark gray-black is the most preferred color scheme.

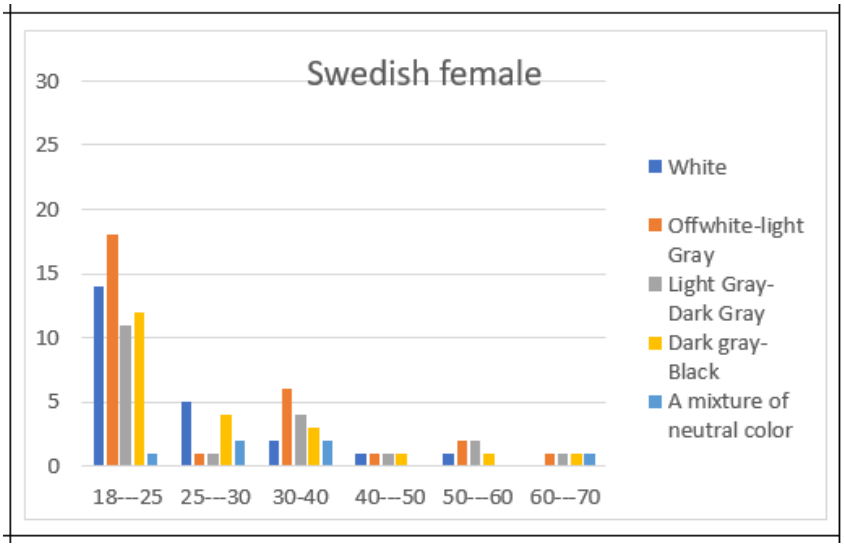


Figure 28. The results indicate that off-white-light gray was the most popular color scheme.

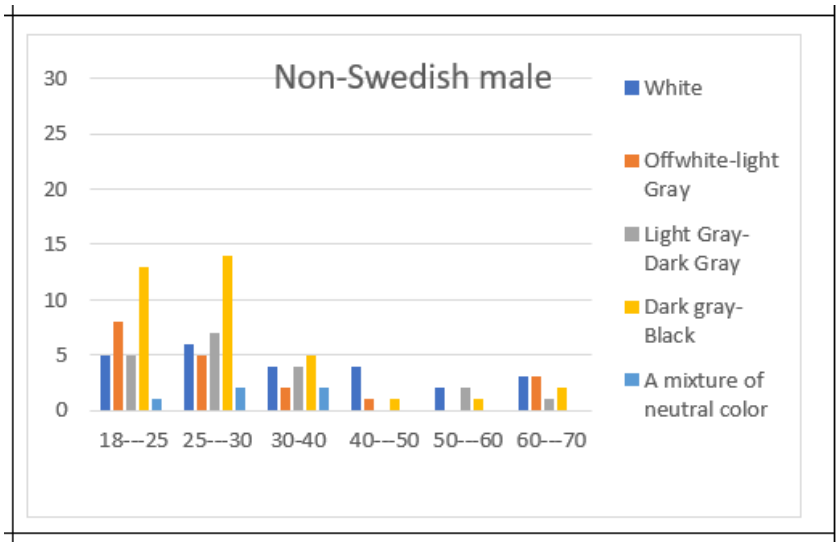


Figure 29. The results show that dark gray-black is the most preferred color scheme.

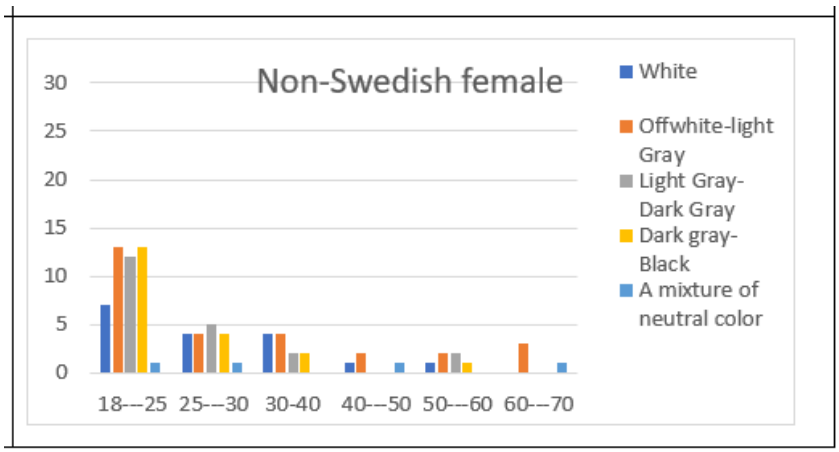


Figure 30. The results show that off-white-light grey is the most popular color scheme, with the light grey-dark grey color scheme in close second place.

4. Discussion

A research study conducted in Sweden employed a participatory planning methodology that integrates the visual preferences of residents into the process of urban design. The study included a VPS^{TM} with over 400 people in order to align urban development with the desires and preferences of the community. The study employs the qualitative approach of photo-elicitation to actively involve participants and collect their preferences. We provide color guidelines or standards by assessing the quality rating of the most prevalent color schemes in residential buildings in Stockholm. This is a useful tool for urban planners, architects, and project developers. The study enhances the discussion on social sustainability in urban planning and emphasizes the significance of including communities in the process of making decisions. The results have important policy implications indicating that urban planning practices should give priority to community involvement and integrate the visual and functional preferences of inhabitants.

However, the study discovered that previous requirements for the color design of architecture and streetscapes in local development projects did not give sufficient consideration to color schemes. Despite research indicating that guidelines or standards aim to control individual behavior for the benefit of society, architects and building companies largely had the freedom to choose any color for the streetscape and architecture. The lack of a comprehensive understanding of color and the complexity of color schemes in the

built environment may also contribute to the absence of methodologies to create such standards. The study quantifies the relationship between visual preference and building color schemes, enabling the establishment of numerical guidelines and standards for colors in the built environment.

Architects may perceive standards and guidelines as unnecessary, as they could limit their creativity and result in monotonous and repetitive color schemes. Architects can create vibrant, colorful, and diverse architecture that highlights local communities' uniqueness. However, radical or inexperienced local project architects may result in a noticeable disparity in color choices compared to community residents. A study reveals that only 5% of respondents in all age, ethnic, and gender categories preferred blue-red, the least liked of the four colors identical to the NCS basic colors. Architects chose blue-red color schemes for many buildings after 2000. This disparity is evident among local project architects and Swedish residents. The study aims to close the color preference gap, allowing the public to have a greater voice in choosing color schemes for future development projects, which would improve social communities and build a sense of community. This would be beneficial even if the margin were not significant.

The study argues that color schemes in architecture should be more flexible, as they are subject to change over time and across regions. The author acknowledges the importance of the architect's contribution to Swedish color culture and aims to provide new tools and methodologies to apply innovative skills while understanding how the public perceives color schemes. The aim is to enhance comprehension of color perception in the built environment, which will foster creativity and public appreciation of the aesthetic values of building façades and streetscapes. What are the differences between color preferences by age, gender, and ethnicity? This is the type of question the architect might consider before choosing the color for a hostel for university students whose ages range from 18–25. This study offers answers to such questions.

However, since the study's participants were required to select their preferred alternative from a range of provided color spectrums, the methodology appears to be under scrutiny as well. A different approach, like "ranking," could potentially yield a distinct outcome and prevent a tendency for participants to gravitate toward the more "extreme" colors in the results. For instance, many participants might select the same option as their second choice but have a completely different preference for their first choice. Under the study's method, this alternative would receive zero votes and rank last. If we use a ranking system instead, this option could receive the most points.

The study selected the survey method to encourage participation, which in turn attracted more participants and expanded the study's scope. This method also facilitates data management and results compilation. These benefits were considered to outweigh the potential "polarization risk." It is important to highlight that the study has a certain bias toward the younger side, with 46% of participants between the ages of 18–25. This bias is understandable, as universities conducted 80% of the surveys.

The results indicate that approximately 30% of respondents over the age of 30 participated in the survey, which included university staff and other community groups. This contributes to the larger sample and, to a certain extent, mitigates the bias. A potential future study could further clarify the attitudes of older age groups toward various colors. The results of such a study could be intriguing when choosing the color scheme of a retirement home, for instance. Moreover, the study did not record the educational background of the various participants. However, since universities conducted a large part of the interviews, it is reasonable to assume that the participants in the study have a somewhat higher level of education than society in general.

The authors hypothesized that cultural context influences residents' attitudes toward color more than education level does. Why did the authors place more emphasis on cultural context than education level? The answer is that Sweden's color culture is deeply ingrained, with people historically choosing colors derived from natural materials. However, the richness of color cultures has greatly influenced the personal preferences of every member

of society, including those in the architectural and design professions. The prolonged aesthetic response of Swedish citizens and architects to the rich culture and broad range of color schemes found in Swedish cities leads the authors to anticipate some degree of shared preference for color. This commonality is visible between the traditional color schemes used in Stockholm's historic area and the results obtained on Swedes' preferred color schemes. The results show that yellow-red was the most popular option among those interviewed with a Swedish background. This may be due to the fact that Swedish buildings have historically had this color, and this preference has become part of a cultural attitude. We can, therefore, reasonably anticipate this outcome.

Instead, blue-green was more popular among the interviewed males from non-Swedish backgrounds, possibly due to their different cultural attitude toward building colors. However, drawing this conclusion is more difficult because women with a non-Swedish background also have a preference for yellow-red. The grayscale colors do not reveal the same cultural disparity. This may be due to a different cultural attitude toward grayscale colors. The results indicate that dark gray-black is most popular among men, and off-white-light gray is most popular among women. This could possibly indicate that men prefer darker colors on the gray scale and women prefer lighter colors.

For now, the application of the method as a novel approach to exploring and fostering social sustainability is more interesting than the results.

5. Conclusions

A Swedish study used participatory planning methodology to incorporate residents' visual preferences into urban design. Over 400 people participated in a survey, providing color guidelines for Stockholm residential buildings. The study emphasizes community involvement in decision-making and emphasizes the importance of incorporating visual and functional preferences in urban planning practices.

The study provides new insights into how people of different ages, races, and genders in Sweden perceive and rank the two main color schemes used in local development projects in Stockholm. We looked at four colors that are similar to the basic colors in the Natural Color System (NCS), as well as four neutral colors that are similar to grayscale colors. While there are four primary color schemes in the NCS, the results show that yellow-red is the most popular.

For grayscale colors, the results show that the neutral color schemes are mostly consistent, with "dark gray-black" being the most popular. These findings prompt us to rethink the current trend of architects imposing their own tastes on users (clients) or, at the very least, assuming that clients will share those tastes. The results also highlight the need for color guidelines or standards aimed at guiding the individual behavior of architects for the benefit of society. The purpose of these guidelines is not to supplant architects' creative roles and innovative skills, but to equip them with a new tool and methodology that enables them to utilize their creative abilities while comprehending public perceptions of color schemes. Various factors appear to influence the preferences and emotional reactions of different age, racial, and gender groups in Sweden toward the color schemes used in local development projects. Using photo-elicitation in a VPS^{TM} that includes diverse groups from around the world can help identify color preferences for local projects globally. The intriguing aspect of this new and open method lies in its application. It will help close the color preference gap between residents and project architects, encourage greater public participation in decision-making, foster a sense of belonging, and promote social sustainability.

6. Future Studies, Limitations and Possibilities

People's preferences are changeable over time and across regions. The results of this study are specific to a particular period and region. Future research could address the limitations of this study and other related issues. Further research is necessary to expand the use of this method to collect data through more comprehensive survey samples. These

samples should encompass diverse genders, ethnicities, educational backgrounds, and age ranges from 18–80 years, with the option to include children or teenagers. Analyzing these collected data will shed more light on the aesthetic and structural preferences for physical and urban features. Implementing such methods allows building companies to tailor their production to specific age, gender, and ethnicity groups, thereby enhancing their efficiency and economic benefits while staying aligned with community preferences. This method can also assist municipalities in improving the efficiency of the planning process. In addition to this study, the authors conducted a separate study to identify the top physical features of buildings that received the highest scores. The authors created an assessment matrix using these features and their quality rankings. The assessment matrix can identify the efficacy of public participation in the planning process.

Author Contributions: K.N. was responsible for the general concept, methodology, writing, data collection, discussion, and conclusions. W.W. assisted with the review, discussion, editing, and visualization of the final version of the publication. Following a peer review process, all of the authors have provided their approval. O.N. supported the whole research process, provided various insightful opinions, and oversaw all of the text that was included in the article. All authors have read and agreed to the published version of the manuscript.

Funding: This research received no external funding.

Institutional Review Board Statement: Ethical review and approval were waived for this study, due to local law.

Informed Consent Statement: Informed consent was obtained from all subjects involved in the study.

Data Availability Statement: The data used to support the findings of this study are included within the paper.

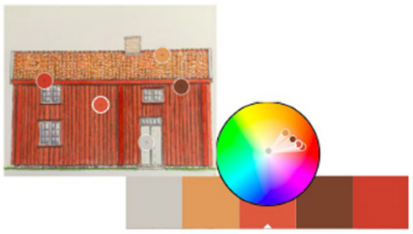
Conflicts of Interest: No conflicts of interest have been made known by the authors.

Abbreviations

VPS^{TM} means visual preference surveys.
NCS means, the Natural Color System (NCS) is *a proprietary perceptual color model*.

Appendix A

A historical review on the color schemes of traditional Swedish buildings from 1700–1800.



Reference for color analysis: The authors.

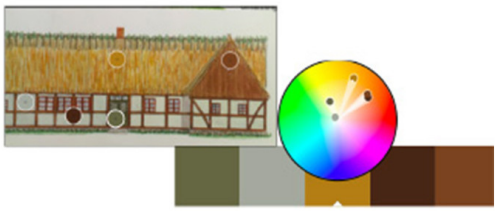
Reference of photo: Så byggdes staden, page 86 by [72].
DALSLAND: Residential building from the 1700s.
The facade was initially unpainted but was painted red in the 1800s. The timber structure was clad with various wide, vertical wood panels [72].
The color analysis shows that the entire color scheme for the cottage is in ochre tones.

Figure A1. Presents an analysis of color schemes in 1700s Swedish architecture in Dalsland landscape.

Reference for color analysis: The authors.

Reference of photo: Så byggdes staden, page 86 by [72].
GOTLAND: Stone building from the 1700s.
The facade is white lime, both inside and outside. The house is built of stone, and the roof is pitched [72].
The color analysis shows that the dominant color is white, with secondary colors of ochre and green on the windows, main entrance, and roof.

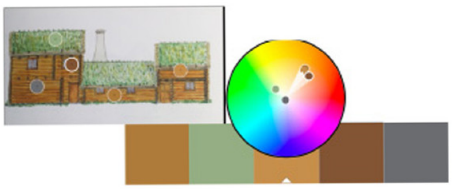
Figure A2. Presents an analysis of color schemes in 1700s Swedish architecture in Gotland landscape.



Reference for color analysis: The authors.

Reference of photo: Så byggdes staden, page 86 by [72].
SKÅNE: The building has a timber structure. The facade is covered with white lime to mimic stone houses. The roof is clad with straw, which requires a steep pitch [72].
The color analysis shows that the main body is predominantly white, with a color scheme featuring secondary colors: ochre on the visible wooden structure and roof, and green on the entrance.

Figure A3. Presents an analysis of color schemes in ancient Swedish architecture in Skåne landscape.



Reference for color analysis: The authors.

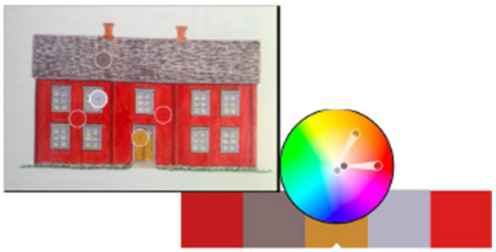
Reference of photo: Så byggdes staden, page 86 by [72].
BLEKINGE: The medieval cottage.
The cottage has a timber structure, and the roof is pitched with a steep angle [72]. The main body is painted in a light yellowish color.
The color analysis shows that the overall color scheme of the main body, windows, and main entrance is ochre, while the roof is green.

Figure A4. Presents an analysis of color schemes from the Middle Ages Swedish architecture in the Blekinge landscape.

Reference for color analysis: The authors.

Reference of photo: Så byggdes staden, page 86 by [72].
ÅNGERMANLAND: Cub-shaped house from the 1700s.
In the 1800s, the house was built with a timber structure and clad with wood panels painted red [72].
The color analysis shows that the main body is predominantly red, with a color scheme featuring secondary colors: ochre on the window frames and roof, and light green for the entrance.

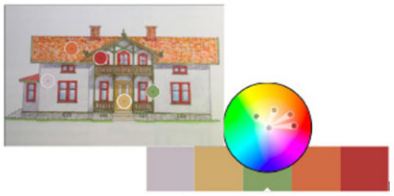
Figure A5. Presents an analysis of color schemes in 1800s Swedish architecture in Ångermanland landscape.



Reference for color analysis: The authors.

Reference of photo: Så byggdes staden, page 86 by [72].
VÄRMLAND: Residential building from the 1800s.
The building has a timber structure and is clad with wood panels painted in falu red [72].
The color analysis shows that the main body is predominantly red, with secondary colors of ochre on the window frames, roof, and entrance.

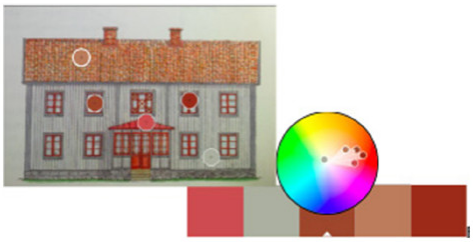
Figure A6. Presents an analysis of color schemes in 1800s Swedish architecture in Värmland landscape.



Reference for color analysis: The authors.

Reference of photo: Så byggdes staden, page 86 by [72].
ÖSTERGÖTLAND: 1800s.
This house is built from timber. The facade is covered with a light lime color on the outside.
The roof is clad with bricks in a yellowish color [72].
The color analysis shows that the main body is white, while the secondary colors for the windows and doors create a color scheme that is more or less ochre. The porch, however, has a green timber structure.

Figure A7. Presents an analysis of color schemes in 1800s Swedish architecture in Östergötland landscape.



Reference for color analysis: The authors.

Reference of photo: Så byggdes staden, page 86 by [72].
GÄSTRIKLAND: 1800s.
The timber structure is clad with wooden panels painted with linseed oil, also known as flaxseed or flax oil [72].
The color analysis shows that the main body has the color of linseed oil, while the secondary colors for the windows, doors, and roof create a color scheme that is more or less ochre.

Figure A8. Presents an analysis of color schemes in 1800s Swedish architecture in Gästrikland landscape.

Appendix B

Style 1800–1880:
The facades were painted in bright pastel colors such as yellow, light gray, or pink. The bases (ground floors) were painted in a stone-like gray.
The windows were painted in darker colors like green, red, or brown.
Reference of photo and text: Så byggdes staden, page 89 by [72].

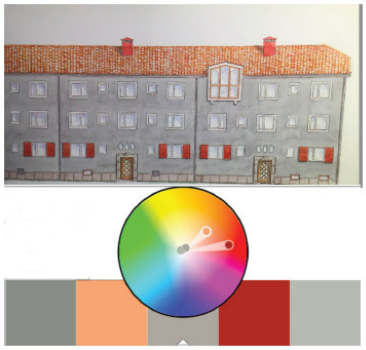
Color scheme after analysis: Yellowish, grayish, and pinkish.
Reference of color analysis: The authors

Figure A9. Presents an analysis of color schemes in 1800-1880s style in Swedish architecture.

Style 1880s:
The dominant colors were yellowish, grayish, or light yellow.
The bases (ground floors) were painted in a stone-like color.
The roof color was black or red.
The windows were dark brownish or dark grayish.
Reference of photo: Så byggdes staden, page 89 by [72].

Color scheme after analysis: Yellowish,grayish,light yellowish, and brownish. Reference of color analysis: The authors

Figure A10. Presents an analysis of color schemes in 1880s style in Swedish architecture.



Style 1950s - Grannskap:
The facade was finished with a coarse textured plaster in dark, moody colors, with muted white shades.
The windows were mostly painted white.
Each house had its own color, often in saturated tones.
Reference for photo and text: Så byggdes staden, page 106 by [72].

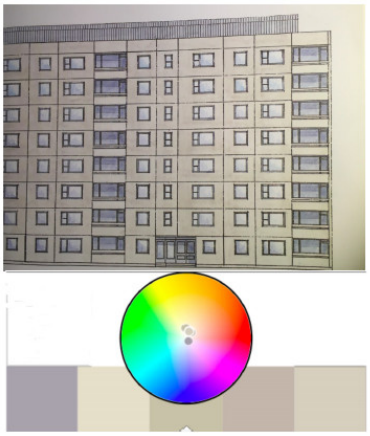
Color scheme after analysis: Orange, grayish, greenish, and reddish. Reference for color analysis: The authors.

Figure A11. Presents an analysis of color schemes in 1950s style in Swedish architecture.

Style 1960s - Record Years:
The most common facade materials were brick and mortar. Facade elements in raw concrete with textured patterns created a distinctive shadow effect.
Reference for the photo and text: Så byggdes staden, page 108 by [72].

Color scheme after analysis: Orange, yellowish, grayish, and redish. Reference for color analysis: The authors.

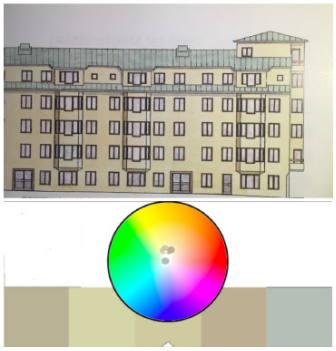
Figure A12. Presents an analysis of color schemes in 1960s style in Swedish architecture.



Style 1970s - Mass Building:
The colors were often grayish or strong and clear, in varied shades. The windows were painted in white or dark colors, often brown.
The villas were given facades of wood, brick, or Mexican stone, commonly in white or yellow.
Reference for the photo and text: Så byggdes staden, page 110 by [72]..

Color scheme after analysis: Grey, grayish, beige, and yellowish. Reference for color analysis: The authors.

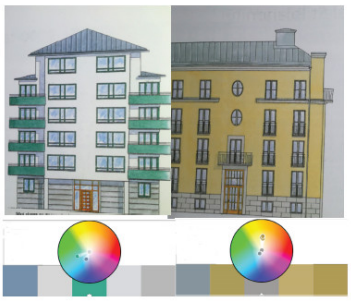
Figure A13. Presents an analysis of color schemes in 1970s style in Swedish architecture.



Style 1980s - District City
Facade materials were used in different colors, including facade tiles with patterns or stained concrete elements. Brick facades often featured diagonal bay windows. House facades with diagonal wood panels were commonly seen in pink color schemes.
Reference for the photo and text: Så byggdes staden, page 112 by [72].

Color scheme after analysis: Yellowish, grayish, brownish, and beige:. Reference for color analysis: The authors.

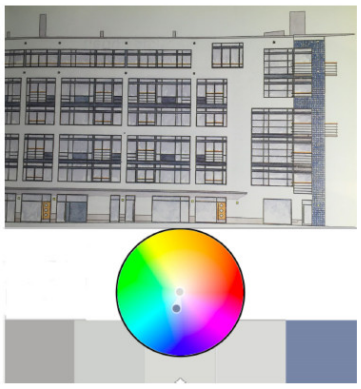
Figure A14. Presents an analysis of color schemes in 1980s style in Swedish architecture.



Style 1990s - Mixing Styles:
1920s classicism-inspired architecture featured regular window settings and colorful facades. By the end of the decade, 1930s functionalism-inspired architecture emerged, with facades often plain in white or light colors. The facade materials of villas were traditional wood but had a schematic character.
Reference for the photo and text: Så byggdes staden, page 114 by [72].

Color scheme after analysis: Yellow, grayish, grey, white, and greenish. Reference for color analysis: The authors.

Figure A15. Presents an analysis of color schemes in 1990s style in Swedish architecture.



Style 2000s - New Modernism:
Simple and plain white plaster or lime facades, sometimes with accent colors, became common, as did facades in gray shades. The color palette for villas included gray or white with details in oak, grain blue, oxide green, or English red. Oiled hardwood became a new common feature in facade architecture.
Reference for the photo and text: Så byggdes staden, page 116 by [72].

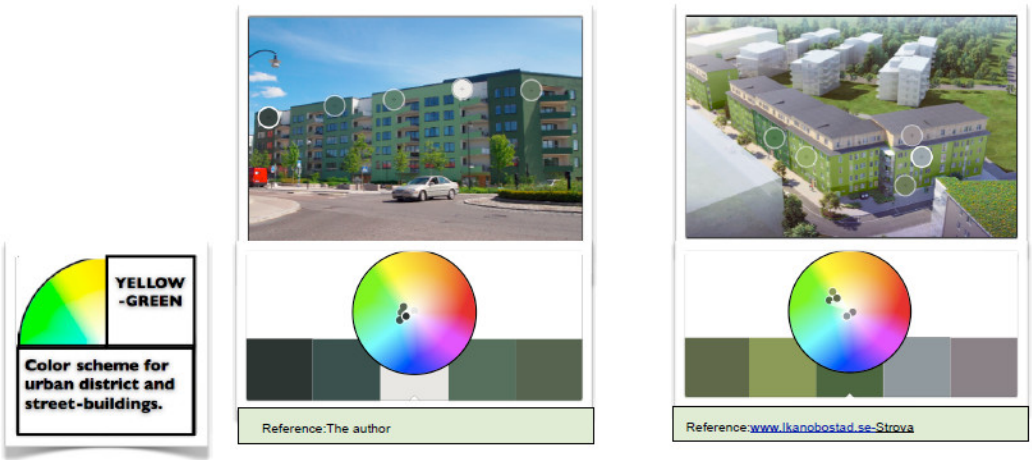
Color scheme after analysis: White, grey, beige, and bluish. Reference for color analysis: The authors.

Figure A16. Presents an analysis of color schemes in 2000s style in Swedish architecture.

Appendix C

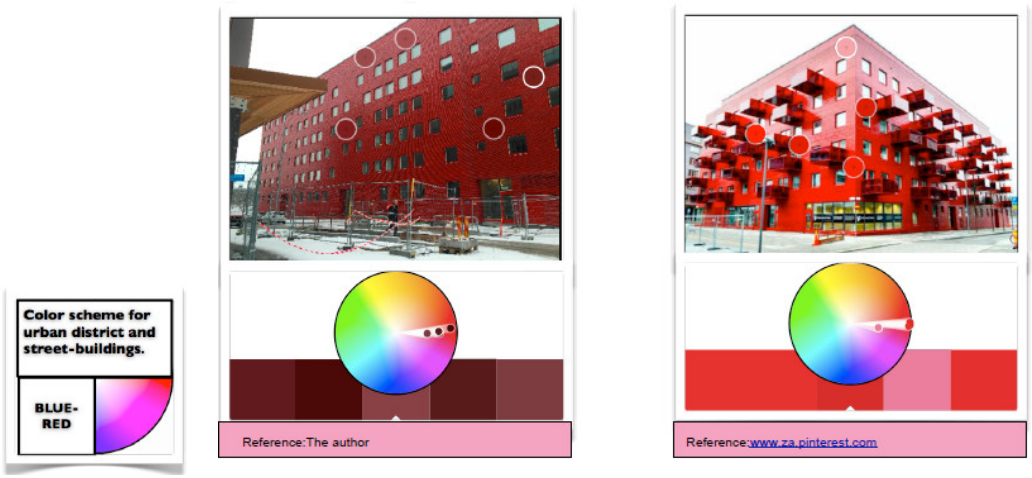
A group of four analogous colors related to NCS basic colors.

Scheme A1. The scheme shows a group of analogous colors located in the sector of the color wheel, which stretches from the yellow-red color.



Scheme A2. The scheme shows a group of analogous colors located in the sector of the color wheel, which stretches from the yellow-green color.

Scheme A3. The scheme shows a group of analogous colors located in the sector of the color wheel, which stretches from the green-blue color.



Scheme A4. The scheme shows a group of analogous colors located in the sector of the color wheel, which stretches from the blue-red color.

Appendix D

A group of four neutral colors related to grayscale colors.

A scan of recent buildings built after 2000 and the recent new planned production of buildings in Stockholm indicates a clear trend toward painting the buildings with pure

achromatic colors such as white, gray, and black. As follows, the author categorized these collections into four subcategories.

Figure A17. Shows buildings that use only white, which is a pure achromatic color.

Figure A18. Shows buildings that have a combination of colors ranging from off-white to light gray on the achromatic color scale.

Figure A19. Shows buildings that have a combination of colors ranging from light gray to dark gray on the achromatic color scale.

Figure A20. Shows buildings that have a combination of colors ranging from light gray to dark gray on the achromatic color scale.

Appendix E

Appendix E.1 Case Studies

Appendix E.1.1 Examining Stockholm's Building and Streetscape Color Standards: A Case Study of Barkarbystaden in Järfälla

Through this review, the researcher aimed to investigate if there are any objective color standards or color guidelines in the design process for the local project of Barkarbystaden. In Barkarbystaden's checklist for environmental and design programs, version 2016.09-19, it stated: A color scheme and façade material should be considered and coordinated with nearby districts; there are no more requirements or guidelines. Only this statement was mentioned about a topic as important as color schemes during a recent local development project in Järfälla.

Appendix E.1.2 Examining Color Standards for Recent Buildings and Streetscapes in Four U.S. Case Studies: Fremont, Chestermere, Seattle, and Livermore

The aim was to investigate what the objective color standards and color guidelines are for local projects in the USA.

1. The city of Fremont.

According to Van Meter Williams Pollack's multifamily design guidelines, which the city of Fremont approved on 8 October 2013, via Council Resolution 2013-64, variations in color and material should typically not happen in the same plane since they might give the structure a "thin" or applied quality. In addition, they insist that structures should not have single-color paint applied to them. Furthermore, massing works better with building mass and pieces that are distinguished by variations in detail, color, or material. It also said that similar building types have a "cookie cutter" appearance when the same materials and colors are used again.

2. The city of Chestermere.

The Chestermere authority specified that different materials and colors will be used on building façades to break up the massive massing of multifamily buildings in the design standards for multifamily residential, commercial, business park, light industrial, and special design zones policy. They said that earth tones would make up the bulk of the color scheme, with a restricted amount of primary and other accent colors.

3. The city of Seattle.

Color schemes are not extensively discussed in the Seattle Design Guidelines, which form the basis of the City's Design Review Program and serve as the main instrument utilized by Design Review Boards to assess proposed projects. The Seattle Design Guidelines state that a building's ability to successfully harmonize with its surroundings depends on the colors used.

4. The city of Livermore, California.

As specified in the home design rules for Livermore, California, residential building colors are regulated to ensure that they harmonize well with the surrounding natural and man-made settings. Thus, building exterior colors have to harmonize well with Livermore's natural surroundings as well as its unique topography and climate. Accent colors should also be used to draw attention to fine features like trims. In general, only neighborhood-appropriate accents and trimmings should use primary colors.

Appendix E.1.3 Findings from the Five Case Studies

It is clear that color schemes are not given enough attention in the design standards mentioned above. Architects are not assisted in selecting color schemes for buildings or streetscapes within the built environment by any specific standards or guidelines. Standards and guidelines, on the other hand, allow for subjective design states. This implies

that even if a color choice doesn't fit the public taste or preference, the architects in charge of the design process can choose it. These findings regarding the absence of color guidelines supported the development of research-based color guidelines for local projects in Stockholm that took into account the preferences of all societal groups. This gap in the practice of creating more social communities, where the public has greater influence over the choice of preferred color schemes for buildings and streetscapes in upcoming development projects, provided this study further impetus to fill.

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