Survey of the Use of the Munsell Color System in Environmental Color Design

Keywords: *Munsell Color System, Applications of the Munsell Color System, Environmental Color, Fractals, Patterns*

Verena M. Schindler[a,c]*, Yulia A. Griber[b,c]

[a]*Art and Architectural Historian, Zollikon, Switzerland;* [b]*Smolensk State University, Smolensk, Russia;*
[c]*Co-Chair of the AIC Study Group on Environmental Colour Design; *Corresponding author: ecd.studygroup@yahoo.com*

INTRODUCTION

The Munsell Color System is a common tool for providing a color standard in a wide range of industries and disciplines. As an internationally recognized standard, Munsell colors find applications in spectrophotometric and colorimetric analysis, the film industry, the design and fashions industries, soil-profile characterization, identification of skin, hair, and eye color (see, e.g.: Landa & Fairchild, 2005; McLeary, 2013; Cochrane, 2014).

However, there is little knowledge regarding how the Munsell Color System is applied in environmental color design. Even less research has examined the use of the system from the perspective of cross-cultural differences and variations with time.

The current study aims to address this gap. Specifically, it aims to examine how the Munsell Color System has been used around the world to support the development of environmental color research, and to teach color and communicate color specifications in environmental color design.

METHOD

1. Design

Data for the study were collected from two different sources. First, an online survey of color professionals was carried out from November of 2017 until March of 2018 to gauge their experience with the Munsell Color System. Second, the study used quantitative content analysis to investigate the meanings, themes and patterns of how the Munsell Color System is applied in environmental color design.

2. Participants of the online survey of color professionals

Participants of the online survey of color professionals were recruited through an AIC (Association Internationale de la Couleur) Study Group on Environmental Colour Design (SG ECD) publicity campaign. The project was publicized internationally through the Study Group mailing list and website, social media channels (Facebook and Twitter), as well as through the partner organisations (AIC Study Groups on the Language of Color (LC) and Colour Education (CE), Inter-Society Color Council (ISCC)). SG ECD members further forwarded the survey to their contacts. Participants were interviewed with the help of an online form and were required to be environmental color professionals.

3. Survey instrument and measures

The survey collected data in a standardized form. The design, wording, order of questions, and the response categories for each question were drawn from brainstorming ideas.

The covering letter of the questionnaire included information about the aims of the study, potential benefits resulting from the survey, details of what will happen to the information provided, as well as the contact names and addresses of the researchers.

The questionnaire included 4 closed questions with pre-coded response options:

(1) Have you ever used the Munsell system in your research?
(2) What was the focus of your Munsell research?
(3) Which other colour systems have you used in your research?
(4) Do you plan to use the Munsell system in your future projects?

Questions 2 and 3 were multiple-choice questions in which participants were asked to select all responses that apply. These two questions also allowed an 'other' response followed by free text.

In addition, the survey collected social and demographical information about age, gender, country of residence, highest level of education, and occupation.

The questionnaire was initially tested for length and clarity on a pilot sample of members of the target population. Before its release the questionnaire was modified. The final survey was built and administered online using Google Forms.

4. Content analysis, materials and procedure

To understand the main directions of the use of the Munsell Color System either in theory or practice, we reviewed the AIC (Association Internationale de la Couleur) Congress and Meeting Proceedings over a 10-year period (between 2008 and 2017).

The codebook that we created for this study specified five areas to be coded.

First, we determined if a paper was relevant to the study. If the Munsell Color System was not used directly in the research, the paper was coded as not relevant and withdrawn from the further analysis.

Relevant documents were then coded in the second area. Here we determined if it was connected with environmental color design or not.

Two additional categories that were coded at this stage included the countries of the authors and the year the paper was published.

Finally, a selected number of papers that used the Munsell Color System in environmental color design theory or practice was coded in a final, fifth area. It was the key category of this study. Here we categorized the main focus of the research into the following:

(1) Interior; (2) Exterior; (3) Analysis of an existent environment; (4) Color planning; (5) Color design;
(6) Color research experiments; (7) Color theory; (8) Color teaching; (9) Other.

The coding scheme was developed deductively. To generate a list of coding categories we used a theoretical model of environmental color design research (Schindler 2017) and looked back at how the concept of environmental color design has unfolded since the 1940s. Originally it encompassed processes of human interaction with surrounding natural factors (e.g., geographical, solar, climatic). More recently, the term implies ecological and sustainable design efforts. Now it is playing a key role in creating the intended atmosphere in indoor and outdoor spaces. Its aim is to improve a sense of well-being and comfort through the construction of aesthetically appealing and environmentally friendly urban and residential facilities and public infrastructures.

All the documents were analyzed by the authors. To ensure the consistency of coding, we develop a coding manual, which included category names, their definitions, rules for assigning codes, and examples (Weber 1990).

5. Data analysis

The data of the online survey of color professionals was collected and collated automatically.

Descriptive statistics, such as frequency counts, were used to summarize findings from the sample. Statistical analysis was completed in SPSS.

The case study method and detailed contextual analysis in depth of a number of cases employing the Munsell Color System was implemented to reveal the impact of this color system on environmental design on all scales of urban space. The fractal approach was used as a tool to understand the environmental color design as a system. Benoit B. Mandelbrot introduced the concept of 'fractal' in his French book *Les Objets Fractals: Forme, Hasard et Dimension (1975)*. Fractals are a way to understand complexity, not just in shapes, but in systems as well. The concept of fractal is especially helpful in allowing order to be perceived in apparent disorder. It suggests that variation and fluctuation on all scales are important and related to each other. It allows the discovery of patterns and rules in the seemingly absolute chaos. Environmental color is no exception: complex and irregular, it is fractal in nature. The fractal approach treats particular elements of urban composition at different scales as integral parts of a whole sharing a common idea. Extending the premise outlined in Christopher Alexander's book, *A Pattern Language: Towns, Buildings, Construction* (1977), the study also explored environmental color as patterns that form a language.

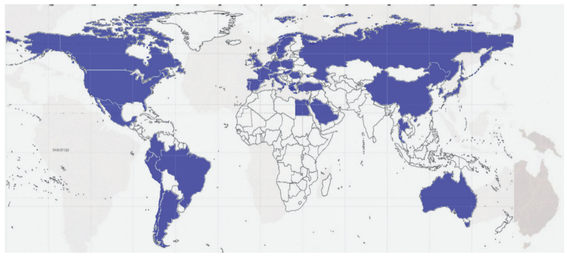
CONCLUSIONS

This study found that various color professionals and scholars from a wide range of disciplines use the Munsell Color System in their work and research. Concerning the age group, the results show a tendency towards professionals over 50 using the Munsell system more frequently than younger people. As well, the survey reveals that almost half of those surveyed having advanced degrees use the Munsell system in their research. Another interesting outcome is that the highest percentage of ECD papers using the Munsell system appear at AIC 2017 Tokyo, followed by AIC 2017 Jeju.

RESULTS

1 Survey results

1.1 Survey participant characteristics



The total sample size of the online survey participants was 202 respondents (86 males and 116 females) from 35 different countries located in North and South America, Europe, Asia, Africa and Australia (Figure 1).

Figure 1. Geography of the online survey of color professionals

Participants were classified into three age groups: under 25, 25–50, and over 50 years (Figure 2 left).

More than one-third of the respondents (39%) held doctoral degree, 28% completed a Master's and 18% a Bachelor's program, 14 % had different professional degrees (MD, JD etc.) (Figure 2 right).

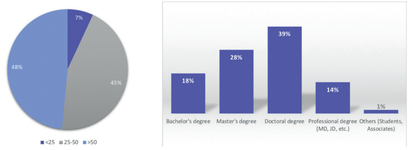


Figure 2. Participant age (left) and highest level of education (right)

Focused around a specific interest in color as a means of environmental design, the range of professions of the survey participants was extensive and included color consultants, architects, landscape planners, artists, designers, art historians, psychologists, educators, managers and directors of related to color institutions, engineers, professionals with medical training and more.

1.2 Socio-demographic profile of the Munsell system users

Two-thirds of the survey participants (66%) from 32 different countries reported some prior experience with the use of the Munsell system in their research (Figure 3).

The overwhelming majority of color professionals who did not use the Munsell colors resided in South America (44%) and Europe (38%) (Figure 4).

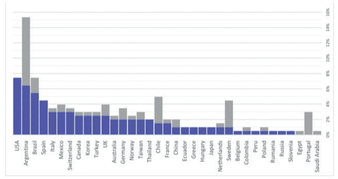


Figure 3. Experience with the use of the Munsell system reported in different countries (in blue); the number of participants from each country is coded grey (as a percentage of the total number of online survey participants)

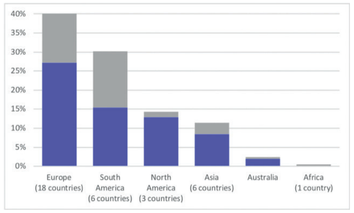


Figure 4. Experience with the use of the Munsell system reported across continents (in blue); the number of participants from each continent is coded grey (as a percentage of the total number of online survey participants)

Table 1. Gender, age and education of the Munsell system users

	Response categories	Have used the Munsell system	Have not used the Munsell system	Total
Gender	Female	74	42	116
	Male	59	27	86
Age	<25	6	8	14
	25–50	49	41	90
	>50	78	20	98
Education	Bachelor's degree	19	17	36
	Master's degree	31	26	57
	Doctoral degree	64	14	78
	Professional degree	17	11	28
	Others	2	1	3
Total		133	69	202

This study did not reveal the existence of a sufficient correlation between the gender of color professionals and their experience with the use of the Munsell system ($\chi2=0.508$, $p<0.05$). However, there were variations identified across the age groups and participants with different levels of education (Table 1). The Munsell system was more likely to have been used among participants over 50 years old (59%) compared to those in the 25–50 age group (37%) and the under 25 age group (5%) ($\chi2=16.725$, $p<0.01$). Color professionals with Doctoral and Master's degrees used this system more frequently (48 and 23% respectively) than respondents with different educational qualifications ($\chi2=13.277$, $p<0.01$).

We also measured the popularity of the Munsell system between representatives of various professions (Figure 5). Our analysis revealed that it was more often used among color consultants, technicians, educators of all levels (school teachers, university professors, lecturers), researcher and scientists, artists, and architects.

1.3 The focus of Munsell research

More than half (53%) the sample reporting any prior experience with using the Munsell system applied it in color teaching. Almost the same number of respondents used this system in color theory (50%) and color research experiments (45%). About one quarter of survey participants (28%) applied the Munsell system in color design. One-fifth of the color professionals used this standard in color analysis of an existing environment (20%), interior and exterior solutions (20 and 17% respectively) (Figure 6).

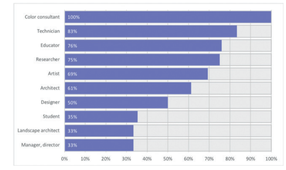


Figure 5. Popularity of the Munsell system between representatives of various professions

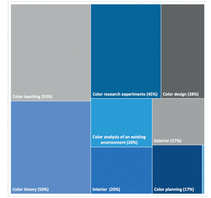


Figure 6. The focus of Munsell research

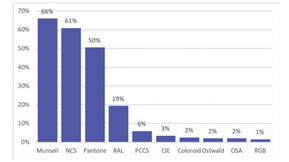


Figure 7. Popularity rating of different color systems

1.4 Experience with other color systems

Only one quarter of color professionals (25%) reported the use of one single color system in their practice (Table 2). Most of them used Pantone (9%) or Natural Color System (8%). The overwhelming majority of those surveyed applied two and more color systems.

The list of color systems named by participants included 21 different color standards. In this Munsell Color System Survey, the most frequently indicated color systems were the Munsell Color System (66%), the Natural Colour System (NCS) (61%), and Pantone (50%) (Figure 7). The top ten popularity rating also included RAL, Practical Color Coordinate System (PCCS), CIE, Coloroid, Ostwald color system, OSA-UCS (Optical Society of America Uniform Color Space) and RGB.

Table 2. Experience with color systems and collections

Color system used in the prior research	%
Only Pantone Color System	9 %
Only Natural Colour System (NCS)	8 %
Only Munsell Color System	5 %
Only CIE	1 %
Only RGB	1 %
Only Coloroid	1 %
2 and more different color systems	75 %

Almost half of the survey participants (46%) expressed the wish to use the Munsell color system in their future projects (Figure 8). Only 15% of color professionals do not plan to use this standard in their work. The study revealed a sufficient correlation between the previous experience of respondents with the Munsell color system and their willingness to work with it later. Those who have already used the Munsell color system in their research responded more enthusiastically to the prospects for its continued application in their future projects ($\chi2=37.389$, $p<0.01$).

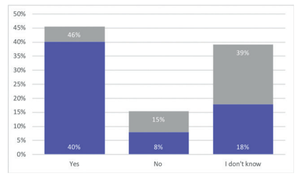


Figure 8. Willingness to work with the Munsell color system in future projects. The number of participants with prior experience with the use of the Munsell color system is coded blue (as a percentage of the total number of online survey participants)

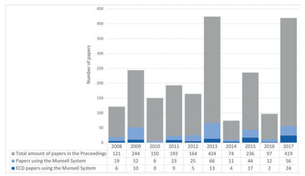


Figure 9. Number of papers in the Proceeding books of the Association Internationale de la Couleur published in the years 2008–2017

2 Content analysis results

2.1 Popularity of the Munsell Color System in the AIC research

At the first step of the content analysis, we selected from the total number of 2,122 papers published in the 10 Proceedings books of the Association Internationale de la Couleur from 2008 to 2017. Of these, 314 papers reporting the use of the Munsell Color System either in theory or practice (Figure 9). Documents were retrieved from the Proceedings of AIC Congresses and Meetings database available at the Association Internationale de la Couleur web page (http://www.aic-color.org/congr.htm). It is worthwhile noting that the real quantity of articles included in each of the proceedings in many cases differs from the quantity specified in the conference Program or Introduction of the proceedings, e.g., the AIC 2009 Proceedings includes 251 papers, but 7 papers appear twice and on the AIC website the number listed is 238 papers because many authors did not show up at the conference. The AIC 2014 Proceedings do not include all the papers, because it was published as a book after the conference and was not intended to be the Conference Proceedings. The AIC 2016 Proceedings do not mention the invited speakers, nor do they include an abstract/paper by them.

Across all the papers using the Munsell Color System, the highest number was written in 2011 (21%), 2017 (18%) and 2009 (17%).

At the next step, we reviewed all the selected papers for their relevance for environmental color design and found 90 relevant documents that we included for coding in the other categories. Almost two-thirds of them were written in 2017 (27%), 2015 (19%) and 2013 (14%).

Finally, we classified the content of these papers to examine it regarding the goals, instrumentation, focus of environmental color research (Figure 10), and to trace their changes over the time (Figure 11) and countries (Figure 12).

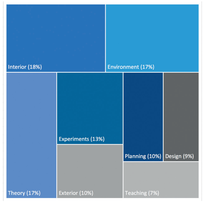


Figure 10. The focus of environmental color research applying the Munsell Color System

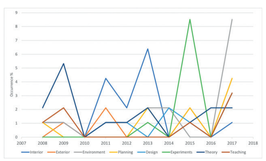


Figure 11. Changes over time in the content of papers applying the Munsell Color System in environmental color design

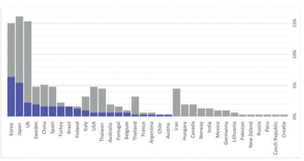


Figure 12. Geography of the authors of AIC papers, using the Munsell Color System. The number of authors from each country is coded grey; the number of authors who applied the Munsell System in environmental color design is coded blue