Color and wayfinding: a research in a hospital environment

Marcia Rangel, MSc[1], Claudia Mont'Alvão, DSc[2]
Ergonomics Lab. LEUI, Rua Marques de São Vicente, 225, Gavea, Rio de Janeiro, RJ, BRAZIL
[1] rangeldesign@gmail.com, [2] cmontalvao@puc-rio.br

This paper presents some results of a larger study – in human factors field - designed to follow-up the interrelationships between users and the hospital environment, regarding its spatial orientation. Among some tools that were used, here are presented the results of a questionnaire that contains several questions about user's perception of hospital´s environment, perception of colors, comparing it colors to a color scale and also questions proposed by Lawton and Kallai' Scale (2002)that compares wayfinding spatial strategies among gender.

INTRODUCTION

In a contemporary hospital, beyond clinical care and surgery - its main characteristics - there are also diagnostic and image services, laboratorial tests and clinic; as well as educational and research activities in its installations. This dynamic nature demands constant expansion and reorganization in the hospital campus, turning hospitals into giant institutions, inferring complexity to its layout and architecture.

Some authors, as Ramanujam and Rousseau (2006), affirms that contemporary hospitals fall far short in applying both state-of-the art clinical knowledge and management practices of known effectiveness.

Given this framework, in the implementation of the hospital activities, the decision-making process becomes complex by the multiplicity and diversity of situations information. Added to that, there are also psychological issues which encompass various emotional states such as anxiety, fear and stress, hampering greatly in the subject's relation with its surroundings. Carpman and Grant (1993, apud Atkins et. al., 2003) affirms that to find the entrance of a hospital and, after that, move to the reception, services or other destinations, are tasks that become complicated with emotional stress or feebleness, although relatively simple activities under normal conditions.

Carpman (2000) affirm that disorientation is a major cause of stress in everyday's life. Research with patients pointed the layout as an important factor in a hospital. Thus, it was verified that hospital patients should never experience the feeling of being lost; and the ability of being situated is a factor that minimizes their stress (Salmi, 2008).

It is in this scenario that the individual must apprehend the space to establish their location. Passini (1980 apud Lam et. al., 2003) argues that to navigate a space, some people depend on the organizational clarity and spatial properties of its layout. Thus, the planning the layout, as well as the relations between different functional areas, has fundamental implications to spatial orientation (Carpman, 2000).

Large individual differences exist in both the strategies that individuals use when wayfinding and their performance in navigational tasks. Over half a century ago, Tolman (1948) observed that certain individuals (of the mice family) and nearly all individuals in certain circumstances have difficulty forming a large-scale cognitive map of an unfamiliar environment, resorting instead to a less effective narrow strip-like map (Baldwin, 2009).

Hunter (2009) says that "good wayfinding design is directed at the broad universe of users: people with a variety of perceptual abilities, bilingual or multi-lingual populations, children and aging users." For the author, global population trends have stimulated new interest in providing for reduced abilities related to aging in universal design generally, such as reduced visual ability, memory loss, physical deterioration (reduced endurance, strength, and balance, requiring motorized compensation in fast-moving environments like airline terminals). And this global population will visit some complex places, as hospitals, mainly if considering that aged people usually need more frequent health care assistance.

Hospitals and colors

Hospitals are "doors" to positive and negative emotions, and their users are almost always under great stress. These systems' efficiency demands spatial orientation that guarantees the sense of place of the users and rapid localization of their destination.

Color usage in hospitals has strong psychological implications and that's why color professionals (architects and designer, mainly) must know about the colors 'effects in people to prospect in their projects the chromatic effects in conformity of their expectative, and also reach a bigger number of users (Heller, 2009).

Heller (2009) verified 160 distinct feelings associated to colors. His studies results also showed that colors and feelings

don't combine in a random way. These associations result from universal experiences, related to language and human thinking since user's childhood. It happens due to psychological symbolism and historic tradition.

The usage of White and soft colors in hospitals are related to concepts widespread by hygienists, that based on scientific rationalism, linked dirtiness to illness and developed "good hygienic" solutions that influenced several aspects of society life in the end of XIX (Forty, 2007). The nurse Florence Nightingale was one of the responsible by the dissemination of this concept of hygiene in hospitals, emphasizing the necessity of maintaining these spaces clean. In this way, white became the biggest symbolic color for hospitals cleanliness. (Rosenfeld, apud Cesar, 2003, p.179).

Pastoureau (1997) affirms that the usage of White color as a symbology of cleanliness, goodness, purity, peace, relies on western society imaginary for a long time, but in XX century this idea was widely retook in hospital environment. The author points out that the hygienic "idea of white" is not related to physical, chemical of physiological aspects, but is a symbolic, ideological and archetype question..

In this manner, this idea of "white cleanliness" guide, from age to age, several human behaviors. The color white, together with soft colors, is deeply involved in people's imaginary as a color pertinent to hospital environment.

Case study

This study aims to evaluate the layout and signaling performance in the displacement process of the unit users: Federal University of Juiz de Fora Hospital [HU-CAS/UFJF].

The main objectives in this research were: verify the displacement of patients and their companions while visiting a hospital unity and how color influences this process; and verify if there were differences considering gender, in wayfinding strategies.

RESEARCH METHODOLOGY

Subjects

Target-users were patients and/or companions aged from 18 to 60 years, in a total of 79 subjects. These patients have a diversified profile, although the vast majority is concentrated in a range of medium to low socio-cultural level. Within varied age groups and physical impairments, thus, many need companions to their tasks in the institution, without employees help. The following requirements are presupposed for these users: displacement autonomy, to be able to read, and to be self-confident in his dislocations. So they can identify the information of current signs, move towards the sectors and find his destination.

Survey instruments and procedure

Investigation was carried out using a questionnaire and a scale: the first, in which was presented both opened and closed questions concerning to the environment and the second, the "Lawton and Kallai Wayfinding Strategy Scale" (Lawton and Kallai, 2002) to examine individual differences among men and women in navigation strategies.

Questionnaire application was conducted in 4 phases:

1) Participants were tested to check vision deficiencies that could affect color distinctions, using Ishihara Test for Color Blindness;
2) Participants answered closed questions in the questionnaire, most of them a Likert-scale;
3) This questionnaire included a visual part, using colored cards, when subjects must choose their preferred colors, and also colors that they consider adequate for a hospital environment;
4) The researcher, using the *Coral Dulux: Language of Colors® AkzoNobel*, examined previously the colors designed in the hospital. After this group of colored cards was presented to the subjects so they could recognize perceived colors in (and where it were applied) in the studied environment.

Lawton and Kallai (2002) developed their researches considering individual differences considering gender in navigation strategies. More males report using an orientation strategy, comprising one's position in the environment and using the most direct route to the point of origin; females, in contrast, describe using a route strategy, consisting of relative locations of landmarks (Lawton, 1994).

Recently, Hund at al. (2008) present the problem: what factors influence the cues included in wayfinding directions? Previous studies have highlighted the importance of sense of direction, environmental familiarity, gender and wayfinding strategies (e.g. Hund & Minarik, 2006; Lawton, 1996; Prestopnik & Roskos-Ewoldsen, 2000; Saucier, Green, Leason, MacFadden, Bell, & Elias, 2002). In particular, two wayfinding strategies or perspectives, have received much recent attention (e.g. Galea & Kimura, 1993; Kato & Takeuchi, 2003; Lawton, 1996; Lawton & Kallai, 2002; Pazzaglia & DeBeni, 2001; Sholl, Acacio, Makar, & Leon, 2000).

To try to find a answer for this question, this research used as second tool the Lawton and Kallai Wayfinding Strategy Scale (2002) that presents to the respondents a 5-point response scale where 1=strongly disagree, 2=disagree, 3=not sure,4=agree, and 5=strongly agree, as in Likert scale.

There is some indirect evidence to suggest that strategy differences emanate from differences in the abilities to use them; males, for instance, have been found to be better able to use an orientation strategy in a large-scale environment (Choi et al., 2006)

RESULTS

Questionnaire

Data analysis of 45 answers was structured in 4 distinct categories: user demographic information; perception about hospital environment; performance during displacement; and color perception in HU-CAS/UFJF.

1) User demographic information - answers about gender, age, academic background/ education, if is a user or a companion, length of stay, frequency of visits in hospital.

Subjects were, in majority, constituted by patients, women, that didn't finished high school, aged from 20 to 30 years. For most of the, that was their first to the hospital, arriving by bus, and spend from 4 to 6 hours in the unit.

2) Perception about hospital environment - mood caused by color [well-being or not], perception for environmental comfort [illumination, temperature], applied colors in hospital environments and provoked sensations.

The HU-CAS/UFJF has a chromatic diction in its two buildings: in block A the color is green, and in block B, blue. In some areas, as waiting rooms and aisles, other colors are also used as red, and ochre.

Using a 5-point scale, most of the respondents choose "agree" to the statement *"I feel calm when in hospital environments*" (n=15). In the same way, the majority (n=13) say that "agree" to the statement *"Hospitals are places where people feel depressed*". Considering another question "*Everytime I go to the hospital, I feel tense*", 17 subjects answered that "disagree".

When answering about illumination and temperature, the majority of respondents (n=21) considered both aspects adequate/good.

When questioned about used colors in the environment and perception of these colors, some answers were not surprising. Some say that "disagree" with the statement "*In hospitals, white walls gives me the sensation of emptiness*", and 25 answered that "strongly agree" that "*In hospitals, soft colors gives me the sensation of hygiene*".

As mentioned before, the 3rd part of the questionnaire included colored cards. It was a set of 22 different cards, selected form a pre-test, when subjects should choose 2 colors: the first, elect their 3 most preferred color, and the second, 3 colors that they believe, are adequate to be used in hospital environments.

The 3 most mentioned colors were Green (N. 6) – 15 subjects; Blue (N. 2) – 14 subjects and Soft Blue (N. 9) – 13 subjects, as shown in table 1.

N. 6	N. 2	N. 9
R = 121 G = 172 B = 53	R = 0 G = 108 B = 157	R = 94 G = 172 B = 218

Table 1 – The three most preferred colors, among 22 colors options.

When electing the 3 colors that they consider be more adequate in hospital environments subjects mentioned White (N. 22) – 19 subjects; Soft green (N. 20) – 14 subjects and Soft yellow (N.17) – 11 subjects, as shown in table 2.

It can be verified that both saturation and luminosity are lower if compared to chosen colors presented in table 1.

N. 22	N. 17	N. 20
R = 255 G = 255 B = 255	R = 253 G = 237 B = 184	R = 227 G = 239 B = 193

Table 2 – The three most adequate colors, among 22 colors options.

The choices were justified by users as "*They are soft colors, leave environment lighter and it looks cleaner*", "*The colors I've choose are neutral colors*", "*Soft colors give the sensation of tranquility and cleanliness*".

Both choices, presented in tables 1 and 2, corroborate that issue of symbolic color aspects. It is clear the "Power" of white as symbol for hygiene and calm. Besides that, the two other chosen colors are widely associated to peaceful and tranquility, as the Idea of cleanliness and hygiene.

3) Performance during displacement - orientation by spatial configuration, by signaling, by oral/verbal information, by colors.

To reach their destination in the hospital building, the majority say that does always the same path, because it is the "easiest"

According to them, they are satisfied with their performance (n=14) and they affirm that do not feel disoriented inside the HU-CAS/UFJF building (n=18). Subjects also answered that is very easy to find the facilities inside the hospital (n=17), and decide which path they must take during their displacement (n=16). But a contradiction is verified when the majority (n=18) say that they need help to conclude their task of dislocating from one point to another.

Some of the subjects (n=7) try to be oriented by spatial configuration, trying to find differences in the environment that could be hints, and few of them (n=6) say that use the signage system, or ask someone else (n=6) to dislocate.

Considering the colors used in signage system, even the answers mention that few of them use it the majority agree that colored signage systems are useful.

Even the designed colors (blue and green) have the intention of orientation questionnaire results indicate that users do not use it as a tool during their displacements. They said "*I didn't use it for orientation.*"; "*Blocks have different colors, really? I didn't' noticed it!*"

4) Color perception in HU-CAS/UFJF: perception of colors of the environment, perception of safety colors coding.

The question in this topic was: "*Here we have some colored cards. Did you notice none and /or some of these colors when walking through the hospital?*" Most of the subjects (n=25) answered yes. It is important to point out that 4 people said they prefer not to answer this group of questions.

But among the 25 subjects, when asked to identify which color was perceived and where, results show a low level of identification, when compared to the color cards. Walls and stretchers protections in the wall were the places where colors more noticed.

Safety color coding was fairly perceived – just 10 subjects indicate that saw these elements, and in a few elements, as fire extinguishers and emergency exit signs.

Lawton and Kallai' Scale

This scale was answered by 34 subjects – patients and companions while visiting HU-CAS/UFJF. This filed survey was carried out in a day after the first one was presented to the hospitals' visitors.

Subjects were equally distributed in two groups – male and female. Data were analyzed using $\chi 2$ test correlating gender, among the answers.

Each question was tested to verify if there were differences when considering male and female responses. But results hadn't shown any individual difference among these groups.

CONCLUSIONS

Users affirm positive and negative sensations when in hospital environment. Depression, tension and stress, as calm and tranquility – are common answers from these subjects.

In this case study, users confirm a positive assess of this environment when evaluate it as pleasurable, comfortable and welcoming. A conflicting aspect was noticed when comparing responses: it is considered a place pleasurable, but also cold.

When asked about color influence in their emotional mood most of the respondents do not consider that "white" give the sensation of emptiness, but some of them said that white color is related to this sensation. We can also find in Psychology' literature review that white color used in wide extensions can provoke the sensation of "interior emptiness".

By the other hand, soft colors and low saturation were preferred by subjects as more adequate for hospitals environments, once they convey sensations as peaceful, calm, and hygiene.

Concerning color in the environment the majority affirm that they could detect color in the space, but they can't be specific when asked where the colors were applied, on which elements. One relevant thing is that, when asked, some subjects look around the colors, to check where they were, and what the colors in that place were. But for most of them, the designed colors of that environment were indifferent for their orientation.

When analyzing Lawton and Kallai' Scale results, it is a suggestion for a further research use other statistical tests to verify if individual differences really don't exist among these subjects.

REFERENCES

Baldwin, C. (2009) Individual differences in navigational strategy: implications for display design. Theoretical Issues in Ergonomics Science, Vol. 10, No. 5, September–October 2009, 443–458.

Cesar, J. C. de O. (2003) Cor e percepção ambiental: relações arquetípicas das cores, seus usos nas áreas de tratamento de saúde. 245 p. Tese de doutorado, São Paulo: USP/ Faculdade de Arquitetura e Urbanismo.

Choi et al. (2006). Sex-specific relationships between route-learning strategies and abilities in a large-scale environment. Environment And Behavior, Vol. 38 No. 6, November 2006 791-80.

Cooper, R. and Berger, C. (2009) What´s new in wayfinding? Develops in hospital signage. Healthcare Facilities Magazine.

Forty, A. (2007) Objeto do Desejo: Design e sociedade desde 1750 São Paulo: Cosac Naify.

Lawton, C. A. (1994). Gender differences in way-finding strategies: Relationship to spatial ability and spatial anxiety. Sex Roles, 30, 765-779.

Lawton, C. A. (1996). Strategies for indoor wayfinding: The role of orientation. Journal of Environmental Psychology, 16, 137-145.

Lawton, C. A., & Kallai, J. (2002). Gender differences in wayfinding strategies and anxiety about wayfinding: A cross-cultural comparison. Sex Roles, 47, 389-401.

Heller, E. (2009) Psicologia del color: cómo actúan los colores sobre los sentimientos y la razón. Barcelona, Editorial Gustavo Gili.

Hund at al. (2008). The Role of Recipient Perspective in Giving and Following Wayfinding Directions. Applied cognitive psychology, 22: 896–916

Hunter, S. (2009) Wayfinding design process. General design issues. IDeA. Center for Inclusive design and Environmental access. Access http://www.u-deworld.com.

Pastoureau, M. (1997) Dicionário das cores do nosso tempo. Lisboa, Editorial Estampa.

Ramanujam, R.; Rousseau, D. (2006). The challenges are organizational not just clinical. Journal of Organizational Behavior. 27, 811–827