

COLOR DESIGN IN HEALTHCARE ENVIRONMENTS: THEORETICAL OBSERVATIONS

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Introduction

The growing demand for research-based knowledge for the application of color in healthcare design prompted the Coalition for Health Environments Research (CHER) to initiate this project. CHER has rightly observed that the evidence-based knowledge for making informed decisions regarding color application was not readily available. While healthcare providers and practitioners in the field have searched for empirical reasoning for color guidelines, healthcare designers continue to make decisions concerning color with unsubstantiated knowledge. This paper is the result of this funded initiative.

The main purpose of this study has been to review the existing research literature on the relationship between people and color in the environment with special emphasis on the design of healthcare environments. (The complete report of this study was published by CHER (Brent Tofle, et al. 2004).

The knowledge base has been fragmented, sporadic, conflicting, anecdotal, and loosely tested. Thus this study has been an attempt to separate common myths and realities in color studies. From the onset of this project we made an attempt to answer two fundamental questions:

1. What is empirically known about human responses to color and how, if at all, color influences human perception or behavior in a specific setting?
2. Which color design guidelines for healthcare environments, if any, have been supported by scientific research findings?

Methods

Utilizing online searches of existing bibliographies and databases in multiple disciplines, systematic research was conducted. In addition, resources from color industries that were made available to the public were examined to the extent possible.

Over 3000 titles were scanned for information on color theory, research, and resources for the healthcare industry. Databases such as PsychINFO, Avery Index, WorldCat, HealthSource, HealthSTAR, as well as Internet search engines including LookSmart, MSN, Google, and Yahoo, were searched for references on the topic. Available copies of the literature were reviewed, seeking to evaluate the

information for empirically based evidence of the service of color to the health field. Unfortunately, citations in languages other than English were excluded.

Following the compilation of the bibliographic list, a first draft of the report was submitted to an expert panel of leading designers in healthcare design and primary scholars in the field of color and health environment research. The monograph was revised based upon the expert panel members' comments and recommendations.

Color and Healthcare: A Summary of the Findings

While the research literature of studies about color use in healthcare environments is fragmented and inconclusive, there is considerable agreement among designers, providers of care and other practitioners that healthcare environments should be friendly, therapeutic, and promote healing to the greatest extent possible. Advocates of evidence-based decisions in the design process of healthcare facilities agree that designers need to consider the functional and perceptual needs of several user groups—the patients, caregivers, visitors, and the community at large (Ruga, 1997).

However, in many of the reported studies the sample sizes were limited, and almost no studies have been replicated to validate findings. Furthermore, because of lack of valid research, findings regarding physiological and psychological effects of color have been repeatedly taken out of their laboratory context and applied indiscriminately to various healthcare environments.

What did we learn from the literature review, and what are implications of this knowledge on colors in the healthcare environment? The following is the summary of the findings.

- There are no direct linkages between particular colors and health outcomes of people. The literature search could not elicit sufficient evidence to the causal relationship between settings painted in particular colors and patients' healthcare outcomes.
- No evidence for a direct connection among colors in the environment and emotional states could be found in the literature. Specifying particular colors for healthcare environments in order to influence emotional states, mental or behavioral activities, is simply an unproductive practice. It is not enough to claim what color can do for people; it is important to distinguish between the explicitly stated aim of such assertions and their latent function. Spaces do not become "active", "relaxing", or "contemplative" only because of their specified color.
- At the same time, there are demonstrable perceptual impressions of color applications that can affect the experience and performance of people in particular

environments. There are indications in the research literature that certain colors may evoke senses of spaciousness or confinement in particular settings. However, the perception of spaciousness is attributed to the brightness or darkness of color and is highly influenced by contrast effects particularly brightness distinctions between objects and their background.

- While studies have shown that color-mood association exists, there is no evidence to suggest a one-to-one relationship between a given color and a given emotion. In spite of contradictory evidence, most people continue to associate red tones, for example, with stimulating activities and blue tones with passivity and tranquility. Clearly, colors do not contain any inherent emotional triggers. Emotional responses to colors are caused by culturally learned associations and by the physiological and psychological makeup of people (Beach, et al., 1988).
- The popular press and the design community have promoted the oversimplification of the psychological responses to color. Color guideline authors tend to make sweeping statements that are supported by myths or personal beliefs. Consequently, most color guidelines for healthcare design are nothing more than affective value judgments. The efforts to prescribe universal color guidelines are futile because of the multiple user groups and their subcultures, and the complexity of the issues of meaning and communication in the environment.
- Tests in isolated, sterile laboratories are perhaps helpful for initial color studies, but they lead to compromised perceptions of the reality because colors are experienced in the real world where complex orders interact with the perception and behavior of people. Therefore, colors have to be studied in an environmental context in which geometry, color, texture, light and other design attributes can be detected and controlled.
- The study of color in healthcare settings is challenging because it occurs in the context of meaningful settings and situations. When we are exposed to a color in a certain setting, we react on different levels. Some of these reactions are cognitive. Others depend on perception, whereas the visual pathway from the eye to the brain triggers other reactions. Analysis of color in any environment also means respecting other kinds of processing forces such as culture, time, and location.

Discussion

To answer the first research question that guided our study, “What is empirically known about human response to color and how, if at all, color influences human perception or behavior in a specific setting?” we can simply state that we

still do not have enough empirical knowledge to answer the question.

The answer to the second question, “Which color design guidelines for healthcare environments, if any, have been supported by scientific research findings?” is: not too many. In other words, there are not enough reliable explanatory theories in this field.

The answers have disappointed practitioners in the healthcare design community because of the expectations that theories in color studies could, perhaps, predict how color might influence people in healthcare settings. Regrettably, most of the knowledge about the implications of color in healthcare environments is based on highly biased observations, and pseudo-scientific assertions. It is this inconsistent literature that has been spun to capricious color trends in the healthcare market. The remainder of this paper discusses the findings.

Color Theory

The body of literature on color spans the disciplines of art, architecture, the physical sciences, behavioral sciences, and the combination of these fields. *Color Theory*, however is an ambiguous term. It addresses the chemical, physiological and psychological aspects of the study and application of color. It combines scientific explanations based on empirical studies with personal assumptions grounded in individual experiences and observations of human behaviors. Obviously, some aspects of *Color Theory* are by definition objective, while individual reactions to color may be plainly subjective. Two fundamental problems arise from this notion. First, since human reaction to color is based on individual choice, it may preclude us from providing scientific explanation for much of our observations, because intentional human behavior cannot be explained in the same way we can explain natural phenomena. It has to include *interpretations of meanings*. Clearly, color-selection, specification, and application are acts that are performed because of their *meanings*.

The second question has to do with the nature of theory. While the definition of the term *theory* is not universally agreed upon, scholars distinguish between positive (analytic, predictive) theories and normative (creative) theories (Lang, 1987; Hillier, 1996). Analytic theories are analogous to scientific theories. Theories in science are sets of general, abstract ideas through which we understand and explain the material phenomena the world offers to our experience. They deal with how the world *is*, not how it *might be*. Normative theories, on the other hand, consist of statements of what ought to be, as Lang (1987) explains:

The scientific method provides rules for description and explanation, not for creation. A design may be derived from scientifically formulated positive theory, but this does not

make it scientific. Normative theory is based on an ideology or world view even if this is not explicitly stated (p. 16).

Color-selection requires theories of possibility in the sense that they exist in art. However, because the design process is also predictive, it needs the analytic theories of actuality and possibility. Environmental design is based on a cyclical process that involves creative as well as predictive phases. The creative and predictive phases of the design process explain the need to use normative theories. The normative aspects of a theory tell the designer where to search for possible solutions in the creative phases, whereas the analytic aspects inform the designer how the solution will work (Hillier, 1996).

In our review we noticed that color theories have too often been strongly normative and weakly analytic. It has been too easy to use color theories to create guidelines and prescriptions for action, but they have been too weak in predicting what the settings will be like when completed and how its colors will influence the users.

Color Studies and the Scientific Approach

The expectations from this literature review have been based on the idea that careful analysis and comprehensive knowledge leads to better design outcomes, or at least better than the ones that may be achieved through an intuitive practice. The hopes for a “good theory” have been grounded in the idea that science is the only approach to explain and understand the world and the way it works.

Replacing the intuitive design process, dominated by imagination, by using reason-based procedure, is not a new initiative. Since the 1960s scholars (Alexander, 1964; Archer, 1970; Zeisel, 1981) have attempted to develop models for understanding the design process. Their assumption has been that the principles of scientific methods can be applied to the design process.

The premise has been that to better predict design outcomes, designers should draw on ever expanding theoretical knowledge instead of using solely aesthetic expressions. The origin of this approach can be traced all the way to Descartes’ conception of rationality, which has dominated much of the Western thinking ever since the 17th century. Adopting these ideas for the field of environmental design introduced one of the fundamental controversies of modernity into architecture, as Hillier (1996) notes:

Descartes’ objective was very similar to that of the twentieth-century design theories. Descartes wanted to rid the mind of the clutter of preoccupations embodied in natural language, and, starting only from indubitable, simple notions, to rework the whole structure of human knowledge. His model was geometry, where we begin from a small number of indubitable (as he thought) postulates and axioms, and use them to create chains of reasoning (theorems, lemmas,

proofs, and so on) and eventually large structures of secure knowledge (pp. 414-15).

The problem with Descartes’ principles is that they have been intellectually perfectionistic. These principles are notorious for cutting away the “inessentials” in order to identify “the abstract core of ‘clear and distinct’ concepts needed for its solution. Unfortunately, little in human life lends itself fully to the lucid, tidy analysis of Euclid’s geometry of Descartes’ physics” (Toulmin, 1990, p. 200). In other words, the rigor of scientific theory is useful only up to a point and only in certain circumstances. The quest for certainty is, perhaps, appropriate within abstract theories, however all abstraction involves omission of elements that do not lie within the scope of a given theory.

Despite the limitations of pure scientific approaches in environment and behavior studies, several scholars argue that the only way this field can make progress is by developing *explanatory* theories. What are explanatory theories? Metaphorically described as maps, theories are “sets of interrelated high-level principles or concepts that can provide an explanatory framework for a broad range of phenomena in a domain” (Rapoport, 2000, p. 112). But, theory building involves more than describing the world. Explanatory theories can contribute to our understanding why things are the way they are, and why the world (or the issue in front of us) is the way it is. In spite of the ambiguous demarcation criterion that distinguishes between science and non-science, that is why scientific explanations have vast practical value. For example, scientific explanation can assist us when we want to explain the occurrence of diseases in order to prevent them or cure them. Scientific explanation can reduce the biases that come from the casual observations we make everyday and help us to better predict outcomes.

When we search for scientific explanation, we ask for factual information. There are, however, several other kinds of explanations, many of which are not scientific (Salmon, 1998). For example, when people repeatedly ask what is the meaning of the white color in a wedding ceremony or the meaning of the black color in a funeral service, we may explain the meanings by reference to iconography of the Western culture. However, *explanations of meaning* are rarely used as scientific explanations. When we speak of *scientific explanation*, we generally ask *why certain phenomena occur*. In many cases, if not always, in order to explain a fact, we need to identify its cause. In other words, our *intellectual understanding* of the world, which derives from scientific explanation, is always *causal*.

However, our literature review revealed very little scientific explanations of the kind that lead to *causal* understanding. A good number of the studies we examined, provided *teleological* explanations or *functional* explanations. These explanations make references to human motives, purposes or goals, which traditionally have been avoided in the

conduct of research in the natural sciences (Salmon, 1998). On the contrary, the application of color in healthcare environments is an intentional human behavior, which needs to be studied in the context of human sciences. As such, the use of functional explanations in this context is clearly rational because it inevitably includes peoples' interests, objectives, beliefs, and feelings (Taylor, 1980).

The risk is, of course, when functional explanations are used to explain causal relations that are, at best, questionable or subjective. We are told, for instance that red is exciting, purple is stately or mournful, yellow is joyful, green is calming, etc. Color consultants tend to repeatedly predict specific outcomes for certain colors used in healthcare environments. For example:

Carefully adjusting the brightness to softer colors of the same hues helps avoid monotony, and in addition keeps the eyes from being distracted, causing them to work overtime and produce fatigue (Brawley, 1997, p. 108).

Orange. Its nature symbol is the sun, defined often by its qualities of emotion, expression, and warmth. Orange is noted for its ability to encourage verbal expression of emotion (Zagon, in Marberry, 1997, p. 229).

The right colors can help to change moods from sad to happy, help dispel loneliness, encourage conversation, and create a sense of peace and well being (Brawley, 1997, p.118).

The problem with these arguable statements is our inability to attribute the outcomes of the human reaction to the prescribed colors. Consequently, these statements are nothing more than affective value judgments whose direct applicability to the architecture and interior design of healthcare settings seems oddly inconclusive and nonspecific. Because it is not enough to claim what color can do for people; it is important to distinguish between the explicitly stated aim of such assertions and their latent function, as Salmon (1998) notes:

In a period of drought, for example, a group of people might perform a rain dance. Although the explicit purpose is to bring rain, the ceremony has no causal efficacy with respect to this goal. Even if rain occurs, it cannot be attributed to the performance (p. 84).

This cautionary advice is echoed in Lorraine Hiatt's (1991) discussion of color in long-term care settings when she argued: "What I take issue with is the notion that there is one color scheme that is going to return the memories of older people; color that will make them dance again or for the first time".

Thus, we naturally become suspicious when a color consultant prescribes a pink color for a patient room in order to influence her recovery from a surgery. The claim that the color of the room caused the recovery is an incomplete

explanation. Because, we have reason to believe that there are additional relevant factors, as yet unknown, that have contributed to the patient's recovery. In our quest for understanding, we want to establish a causal account for the recovery. Therefore, we first need to look for evidence in the past in which the presence of a pink color contributed to the recovery of a patient. If the color has had a result or a consequence in past recoveries, it can help us to establish a causal account. However, it is important to notice not just whether a particular color choice has had certain consequences in the past, but whether the choice of a specific color is causally responsible for the patient healthcare outcomes in the present instance.

In our literature review we could not find studies that provide causal explanations for the effects of colors on people in healthcare environments. In other words, we did not find sufficient evidence in the literature to the causal relationship between settings painted in particular colors and patients' healthcare outcomes.

Understanding Meanings

As we have already noted, the understanding of meanings is central to the studies of color. The problem of understanding meanings of color appears in various contexts such as language, rituals, symbols, concepts, art objects, and environmental design. While the natural sciences since Galileo had succeeded by ignoring any meaning their objects have had for human beings, in the human sciences, these meanings are precisely what we need to understand (Rouse, 1987). The understanding of meanings of color in a wide range of contexts may help us to understand part of the world of human activity. Therefore, ignoring human conscious and unconscious behavior in studies that seek to explain the psychological and physiological effects of color on people is clearly pointless. In order to understand a person's behavior we need to know his or her motives, values, desires, beliefs and purposes. If we understand the person we may be able to predict that person's emotional reactions and behavior. However, human beings are free agents and therefore predictability may be problematic. Thus, to predict how a particular person may react to specific colors, which are supposed to contribute to his or her healing process may be very difficult. Moreover, to predict how different people from diverse backgrounds with various motives, values, desires, beliefs and purposes will react to prescribed colors in healthcare environments is perhaps pretentious and impractical.

Clearly, any satisfactory understanding of human behavior in reference to color requires interpretations of meanings. In his attempt to further social theory, Herbert Blumer formulated in the late 1930s the term "symbolic interactionism". He asserted that meaning forms the very basis of society and that the foundation of meaning is the

sign or symbol. Blumer (1969) summarized the essence of the theory in three basic premises:

The first premise is that human beings act toward things on the basis of the meanings that the things have for them ...

The second premise is that the meaning of such things is derived from, or arise out of, the social interaction that one has with one's fellows. The third premise is that these meanings are handled in, and modified through, an interpretative process used by the person in dealing with the things he encounters (1969, p. 2).

Based on these premises we can conceptualize the issue of color in healthcare design as a set of cues that are part of the situational context of meaning. This view emphasizes "meaning as a communicative process located in interpretive acts, whose study demands close attention to the uniqueness and variability of situations as well as to the way situations reflect habitual attitudes of mind" (Rochberg-Halton, 1986, pp. 43-44). The strength of this approach to meaning is perhaps its emphasis on the living process of interpretation, which gives novelty, uniqueness, and an individual character to a situation. What is important about the subjective interpretation in reference to color in the healthcare environment (as in other environments) is that the person can integrate the interpretations with the ultimate goals of his or her existence as a member of the wider community.

The study of color in healthcare settings is challenging because it occurs in the context of meaningful settings and situations, "whose interpretation is always potentially open to challenge based upon different interpreters' interests, situations, or prior beliefs" (Rouse, 1987, p. 46). When we are exposed to a color in a certain setting, our judgment is a result of a reciprocal process that involves several levels of experience. We first acquire direct sensuous information through our visual perception. This input is analyzed against our background of cognitive information on that environment and that particular color which we have obtained from our culture. The consequence of this process is dialectical: "cultural standards modify perception and perceptual input, in turn, modifies our aesthetic response" (Fitch, 1988, p. 5).

But this process does not take place in a vacuum. It occurs within a web of experiential conditions, which inevitably modifies our judgmental process. Thus, if the healthcare setting is too noisy, or too cold, or the place is cluttered with all kinds of medical equipment and bad odors, the aesthetic experience of our response to its color will be affected, regardless of its "objective" meaning. In addition, our response is influenced by our role in the settings (whether we are patients, staff members or visitors to the facility). Furthermore, a large host of internal forces are involved in the act of reaching aesthetic conclusions. Among them are our physical condition (i.e., whether we feel sick or suffer from pain, how tired we are, whether we lay in bed or work out as part of our physiotherapy, etc.) as well as our psychological state (i.e., whether we are aware of our

surroundings or we are under the influence of drugs, or whether we are anxious about certain medical procedures, or suffer from dementia, etc.).

Based on this short analysis it is clear why the general laws that cover the individual's response to color will continue to be difficult to formulate, and the reasons that there is no guarantee that we will be able to reach an agreement over the interpretation of meanings of color in healthcare environments. The problem is part of the larger question of culture-environment relations, which stems from significant changes in the context of design and the cultural responsiveness to it.

Conclusions

In conclusion we want, first, to reiterate our claim that the use of color in healthcare settings, currently is not based on significant research. Obviously the normative statements in the form of prescriptions for color in particular environments need to be supported by better understanding. If we want to have evidence-based guidelines, we need to understand what particular colors are supposed to do, and why, before we can proceed to implement them in a healthcare setting and before we can judge whether these colors do it well.

Second, the attempt to formulate *universal* guidelines for appropriate colors in healthcare settings is ineffectual. The plurality or the presence of multiple user groups and subcultures, and the complexity of the issues of meaning and communication in the environment make the efforts to prescribe universal guidelines an unproductive undertaking. This is because designers may attempt to endow healthcare settings with cues that the users may not notice. If they notice the cues, they may not understand their meaning, and even if the users both notice and understand the cues they may refuse to conform (Rapoport, 1987). Therefore, our efforts need to concentrate on the *particular* through the formulation of explanatory theories and empirical studies with the aim to give attention to specific and concrete problems rather than abstract and universal questions. Our focus needs to be on problems that do not occur generally, but come about in particular types of situations.

Third, we need to return to the *local*, and study systems, practices, and experiences in their local context of their traditions. We need to look at the ways they are embedded in their milieu instead of aspiring to test their universal validity. In other words, we need to identify and define the groups for whom we design and prescribe colors. Because there are so many groups of users with different cultures in present healthcare settings, we need to identify these groups and design for (and with) these specific *users*. We need to understand the society and the culture against which our interpretation takes place. At the same time, we need to look at the problems and the solutions we study in their temporal or historical context, and to explain them from this

perspective. Designers need to *discover* what is important rather than *assume* that guidelines can cover every possible eventuality and provide solutions for all design challenges.

And, last but not least, we need to match up the methods that should be used to study and realize color in healthcare environments. The methods should be appropriate for the study of “meaning” and “interpretation”. Because the subject matter of color in healthcare environment is complex and multifaceted, it requires holistic understanding of the phenomenon, which is better served by the search for the unifying nature of a particular setting.

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