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Designing Healthy Spaces: Physical and Emotional Response to Color in Built Environments

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DESIGNING HEALTHY SPACES: PHYSICAL AND EMOTIONAL RESPONSE TO COLOR IN BUILT ENVIRONMENTS

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INTRODUCTION

The task of designing built environments involves making many decisions regarding lighting, materials, finishes and color, just to name a few. All these elements come together in order to create environments for the public that will serve its uses and delight its senses. Color, in particular, is a variable that interior designers can use to effectively promote healthy and positive reactions to built environments. Conversely, color can be severely misused, so that its effect on the public can be very detrimental. Faber Birren, an eminent color researcher said, "If the psychological and physical needs of masses of people are to be served, colors should not be chosen on whim or impulse" (Birren, 1978, p. 108). Thus, the role of the interior designer is integral to creating spaces that exert no undue stress to the average person. Rather, the goal is to create spaces that will enable the average person to function more effectively while enjoying their surroundings.

The purpose of this study is to provide evidence that color, as an environmental factor, reaches far beyond mere aesthetics, and has very real effects on human beings. Furthermore, based upon a literature review, I will provide a framework for healthcare designers to aid in their color and finish selection in order to be the most beneficial to the captive and non-ambulatory populations in healthcare settings.

LITERATURE REVIEW

In order to define methods interior designers should use to determine color schemes, one must understand color and one's experience of color from many aspects, including scientific, physical, mental and emotional. An explosion of color research on

these topics occurred in the 1970's and 1980's, but since the field has been largely left alone. This lack of current research has left interior designers with limited concrete foundations upon which to build solid color theories, which especially in healthcare settings, can be detrimental to the public. Despite the lack of fresh knowledge in regards to color, it still remains vital that interior designers use what knowledge *is* out there to create the most beneficial environments for the public.

Color researchers as a whole may not agree on the exact measure and effect of color on human beings, but they do agree that there is an effect, and that colors should be chosen in order to prevent physical, emotional and psychological harm. The following research covers some of these topics.

Color is a concept that inhabits two very different worlds: scientific and emotional. Yet, these two worlds come together in order to for humans to perceive color in a meaningful way. Color can mean many things to different people; they may see or experience it differently. It is important for people, especially those in design professions, to understand the specific ways color affects humans from scientific and emotional aspects.

HISTORY OF COLOR SCIENCE

Color can be viewed purely as a science as it has measurable and quantifiable properties. The first great color theorist was none other than Leonardo DaVinci. DaVinci's *Treatise on Painting* was the first to describe primary colors and laid out the premise of complementary color schemes. Sir Isaac Newton, who also discovered the rainbow of colors as light passed through a prism, was the first to develop a color wheel

in the late seventeenth century (Birren, 1963). In order to experience color, one must physiologically process the image with the eye. Color researcher Robert Crone said, "Color is a mechanical happening which affects our eyes, and thus – through a physiological link – produces in our minds the sensation of color" (Crone, 1999, p. 249). Johann Wolfgang von Goethe, a German poet, also backed the theory that the eye and brain work in tandem to sense color. While this is a very scientific process, Goethe also felt strongly that the process was as dynamic as it was scientific. Color psychologist Heinrich Frieling wrote of Goethe, "[he] felt that Newton and the physicists who supported him failed to do justice to the experience of color in our everyday life, its dynamic flow, which was as much a part of color as the mathematics of optics" (Herman Miller, Inc., 2006, p. 1). Clearly, the experience of color is not neatly summed up in scientific theory; its reaches extend much further than light and its effect on the eye.

PHYSIOLOGICAL EFFECTS OF COLOR

What happens to color information when it reaches the brain? How does the brain interpret color information and how does it react to color? There are several phenomena that every interior designer should understand. These are: color constancy, metamerism, simultaneous contrast, optical mixture and spatial dimension.

Color constancy deals with the ability of the brain and the eye to make minute adjustments in our perception of color so that one color – even if viewed under two different light sources – appears to be the same. We know that the color red, viewed under fluorescent lighting will look different to an identical red viewed in daylight.

Rather than a constant barrage of brain signals telling us that the color is indeed different, the brain adjusts the color for us so we perceive the colors to be the same (Pile, 1997).

Metamerism is color phenomenon that also deals with varying light sources. When designers are trying to produce an exact color match, the colors should always be viewed in the setting where it will be located. All light sources have different color temperatures. For instance, fluorescent lighting produces a cool, bluish light, whereas a halogen bulb will produce a warm yellowish tone. The bulb's particular color temperature will make one color appear to differ under varying light sources (Pile, 1997).

Another color phenomenon is simultaneous contrast. This phenomenon theorizes that the color of an object is dependent on the colors that surround it, and the concept that the brain is always seeking and/or producing the complement to that color. If one were to stare at a grey square on a green background, the grey square would begin to have a reddish tint. That is, the brain has created the complementary color to green – red – and imposed that onto the grey square. The theory of color constancy explains why one may see an afterimage of a color after staring at an image of its complement for a period of time. This is true for any set of complementary colors – red/green, blue/orange, and yellow/purple. This knowledge that the eye will seek or the brain will create a complementary color is very important for interior designers. Designers can intentionally add the complement of a color (it need not be a very large area), to provide visual relief. If the complement is already present, the brain will not need to seek it out (Pile, 1997).

Spatial dimension is a concept that many people are already very familiar with. The idea holds that our brain will add or subtract distance to an object depending on its surface color. Reds, yellows and oranges – considered warm colors – will appear to

advance and appear to be larger. Green, blue and purple – cool tones – will appear to recede and will be perceived as smaller (Herman Miller, Inc., 2006).

One of the most common themes in color research is color's effect on body functions such as heart rate and blood pressure. As warm colors such as red, orange and yellow can evoke feelings of energy, excitability and possibly even anxiety, these colors are sometimes thought to cause one's blood pressure or heart rate to rise. Conversely, cool colors are believed to be calming, serene and peaceful, and are thought to have relaxing effects, even to the point of slowing one's heart rate. Faber Birren says that red may indeed raise heart rate and/or blood pressure, but the effects will not be sustained for long. He observes that after being exposed to red for an extended period of time, one's heart rate may rise, but after a long period of time, the rate will slowly fall and may even drop below normal levels (Birren, 1978). Fellow color researcher Felix Deutsch claims that responses to hue are subtle and may not follow a predictable pattern. This creates much difficulty when trying to prove a single hypothesis when studying physiological response to color – many factors can affect the outcomes. Deutsch summed up his research with two points:

1. Color brings about a reflex action upon the vascular system, if only through feelings and emotions.

2. The effect achieved is not specific for any one or any certain hue. Warm colors may calm one person and excite another. Cool colors may likewise be stimulating to one and passive to another (Birren, 1961).

Both Birren and Deutsch agree that color can have a physiological effect on humans, but stress that the color itself is not the only variable in physiological changes. Deutsch

strongly believes the memory-associations tied to a specific color have more of an effect than the color itself. Birren argues that the application of varying colors, grounded in a strong knowledge base, will have a more positive effect on people than one single color. "From these observations, it is clear that physiological and psychological color reactions, to be actively maintained, require constant change and sequence" (Birren, 1978, p. 105).

More recent research also concurs that specific hues don't have as much as of an effect as people commonly think. Researchers Acking and Kuller (1972), Lars Sivik (1970), and Byron Mikellides (1990) all found that chroma, or the saturation or strength of a color, has much more of an effect on us than hue. In other words, we perceive a strong red and a strong green as equally exciting, while we perceive dull colors, no matter what the hue as calming. These researchers also found that arousal was heightened by multiple hues in an environment and was maintained over time by change and fluctuations in hue (Herman Miller, Inc., 2006, p. 7).

Richard Wurtman, a nutritionist at Massachusetts Institute of Technology believes that color can indeed change one's physiological status. He states, "Several experiments have shown that different colors affect blood pressure, pulse and respiration rates, as well as brain activity and biorhythms. As a result, colors are now used in the treatment of a variety of diseases" (Malkin, 1992, p. 55). What isn't made explicitly clear in his statement is that the "colors" used in the experiments are selected wavelengths in the electromagnetic spectrum of light. This study does not attempt to claim that a wall painted red will increase a patient's heart rate or blood pressure, and therefore does not promote the theory that red is an exciting color and green or blue is calming or relaxing. Faber Birren suggests that all colors can be psychologically therapeutic, dependent upon

its use (Birren, 1978). These findings reinforce the difficulty that designers face when choosing color schemes for healthcare environments. There is no prescribed set for selecting colors that will prevent harm, so designers must choose color based upon knowledge of current color research.

EMOTIONAL AND PSYCHOLOGICAL REACTIONS TO COLOR

Clearly our brain has predictable reactions to color, but what does it do to our emotions? Can it help us feel better, make us smarter, give our emotions a boost? Color can definitely do all of these things, but one person may not react to color the same way as someone else might.

Researcher Deborah Sharpe tested the color preferences of clinically depressed individuals to determine what effect, if any, one's emotions had on color perception or preference. Prior research indicated that depressed patients would prefer dark neutrals and would be disagreeable to bright or primary colors. Sharpe found the opposite to be true. The author hypothesized that the attraction to bright colors was a function of homeostasis, where patients attempted to counter their internal bleakness with bright colors in their external environment (Sharpe, 1974).

While the previous study focused on individuals with a diagnosed mental disorder, the majority of the population will not react so uniformly to color. So much of color preference and perception is dependent on capricious variables such as emotions and personality. The Rorschach test claims, "an emotionally responsive person will react freely to color, while one who is emotionally inhibited may be shocked at the intrusion of bright or primary colors. A person who is rigid or emotionally indifferent may remain

unaffected by color" (Birren, 1961, p. 137). Based upon the findings of this study, it would be impossible for interior designers to choose color schemes based upon the personalities or characteristics of every person who may inhabit the space. However, it does underscore the need for variety in color schemes so that the largest number of people might be accommodated in their preference of color.

Color is present in many facets of our lives beyond the simple act of seeing a color. Many factors affect how we see it, how it makes us feel, and our ultimate perception of that color. Scientist Hazel Rossotti wrote,

> Not only are sensations of color affected by illness, injury and drugs, they depend on the area and shape of the object, its distance from the eye, its position relative to the eye, the intensity of the light, and the colors generated by the rest of the visual field. Nor is the sensation dependent only on what is front of the eye at one particular perception. And, since our experience of color is affected by our memory, by our knowledge of what color some object really is, we could claim that our color sensations are, in a sense, influenced by a lifetime of visual experiences. (Herman Miller, Inc., 2006, p. 1)

Clearly, color plays an important role in our everyday lives, and must be executed intentionally and enjoyed thoroughly for one to fully experience all its benefits. Color researchers Frank and Rudolf Mahnke wrote, "Response to color is total." (Mahnke, 1978).

RECOMMENDATIONS FOR COLOR IN HEALTHCARE ENVIRONMENTS

The charge and challenge for interior designers is how to appropriately apply this varied and contradicting color research to design public spaces where people depend on the environment for healing and care. Healthcare designer Jain Malkin wrote, "The fact that a patient is captive and cannot easily leave the treatment environment puts a great responsibility on the designer to select a color that will not be detrimental to the patients' feeling of well-being" (Malkin, 1992, p. 56).

Malkin pointed out that patients are most often non-ambulatory in healthcare spaces, meaning that they are not able to leave of their own volition. This fact makes a designer's role important so that sensory deprivation does not occur. Sensory deprivation is a condition that can occur when there is a lack of stimulation in one's environment. Faber Birren accepts the following statement, made by M.D. Vernon, as a basic law of color application in human environments:

> Thus we must conclude that normal consciousness, perception and thought can be maintained only in a constantly changing environment. Where there is no change, a state of 'sensory deprivation' occurs; the capacity of adults to concentrate deteriorates, attention fluctuates and lapses, and normal perception fades. In infants who have not developed a full understanding of their environment, the whole personality may be affected, and readjustment to a normal environment may be difficult. (Birren, 1978, p. 98)

A study by Herbert Liederman sought to study the effects of sensory deprivation on individuals captive in healthcare environments. The study included seventeen volunteers (not already ill), who were placed in a respirator for thirty-six hours, only able

to see a small patch of the white ceiling. Only five of the seventeen volunteers lasted the full thirty-six hours. Liederman concluded, "All reported difficulty in concentration, periodic anxiety feelings and a loss of ability to judge time. Eight reported some distortions of reality, ranging from pseudosomatic delusions to frank visual hallucinations" (Birren, 1978, p. 100). This study illustrates the dire consequences that come from a lack of sensory stimuli. Also, while this study only measured the effects on patients when confined to a totally white space, further research should study the effects when confined to a space consisting only of red, orange, blue, purple or gray. These proposed studies might further substantiate the findings of Leiderman's research.

How does one prevent sensory deprivation in a healthcare environment? Can there be too much stimulation within a single environment? Authors Mahnke and Mahnke describe extreme unity as understimulation within an environment, which may cause restlessness, excessive emotional response, lack of concentration, and irritation. Likewise, extreme complexity is overstimulation within an environment and may cause increased muscle tension, anxiety, fear and irritability (Mahnke and Mahnke, 1987). Interior designers walk a fine line between unity and complexity within healthcare environments, in order to simultaneously prevent sensory deprivation and sensory overload. Unity within the interior environment is essential to create a cohesive design. In other words, trying to incorporate all the colors of the rainbow into an environment, aiming to please all color preferences, would look out of place and may even create a chaotic environment. Complexity within the environment is just as important, but like the concept of unity, it can also be taken to the extreme. Without incorporating some variation in hue, value or chroma, a space would appear dull and boring. If one were to be

exposed to such an environment for an extended period of time, it may even lead to sensory deprivation.

Based upon research presented in this thesis, it is clear that there is no single right answer for applying color in healthcare environments. However, there is research based upon physical, emotional and psychological reactions to color that can point interior designers in the right direction when designing healthcare spaces. Within a hospital or healthcare facility, there are major areas of concentration where color selection is very important. Some of these spaces are corridors, nurses' stations, therapy or exam rooms, and patient rooms. In these spaces, designers can use the principal of functional color to direct their color choices. "Functional color makes every color choice on the basis of the function (purpose) of the element under consideration" (Pile, 1997, p. 99). Pile suggests that designers take into consideration the worth of the color itself, as well as the purpose of the space it will inhabit. Using these two factors as criteria, designers will be able to judge the merit of a particular color application within a space.

The corridors of healthcare spaces will set the tone for the rest of the facility or that particular unit within the facility. It is important that the environment makes the patient feel welcome and relaxed, and causes no undue stress on an already worrisome situation. Faber Birren suggests using white or off-white on ceilings, a light to medium tone on the floor, and a medium beige on the sidewalls. To add color and interest, Birren suggests using a medium to deep accent color on end walls. The corridors can be the introduction to a theme for a unit, such as obstetrics or pediatrics, or it can denote a certain location with the hospital, such as an entire floor (Birren, 1978).

Nurses' stations should generally follow the scheme of the corridor, as these stations are usually visible from main hallways. To distinguish nurses' stations from the general corridor, the back wall of the station should be a bright or a medium to deep accent color (Mahnke and Mahnke, 1987).

Designing therapy or exam rooms affords much greater leeway than in other spaces, due to the wide variety of procedures or exams performed in these spaces. A range of colors from a pale aqua or green to a pale peach or coral is acceptable for treatment areas. Specifically, pale greens and aquas are best for treatments in cardiology, cytoscopy, orthopedics or urology. Pale coral, peach or melon may be best for obstetrics and gynecology and dermatology. Bright or intense colors should generally be avoided in these areas to prevent feelings of chaos or anxiety (Mahnke and Mahnke, 1987).

Colors for patient rooms are as important as corridors in healthcare environments. Because patients may be confined to their rooms for a long period of time, it is important the space be restful enough for a convalescing patient, but also provides enough stimulation to prevent sensory deprivation. In a patient room, the wall opposite the window should be kept light in color, as a dark color would absorb natural light and cause uneven illumination. Likewise, the window wall should also be kept light to prevent too much contrast between a dark wall color and bright daylight. Color is best applied on the headwall of the room, or on the wall opposite the patient's bed. The color chosen for these walls must be carefully considered, however. Certain colors may cause an unflattering reflection onto the patient's skin tone. A yellow-green should always be avoided in this circumstance, as it would cast a sickly light onto the patient. The lighting within the room must also be a consideration when choosing colors. In most cases, a

large fluorescent fixture is mounted above the patient's bed to provide adequate lighting for healthcare providers. Fluorescent lighting gives off a cool tone, which may be unflattering to an ill patient. Choosing a color to counteract, or at least minimize this effect may improve the appearance of the patient. Ceilings are another area where color may be applied. Because of the patient's supine position, the ceiling color may be a 50% tint of the accent color, or another contrasting color. The ceiling of a patient's room is often ignored, but is a logical place for adding color within the environment (Mahnke and Mahnke, 1987).

In addition to these specific areas that generally make up large portions of healthcare facilities, there are some tips in regards to color selections that healthcare designers should know in order to intelligently apply color to all healthcare spaces. First, regardless of whether they are classified as healthcare or not, all interior environments should have a change of color brightness (value), temperature, intensity (chroma) and the addition of the complement of the dominant color. This is true for all environments; the color scheme of the space should not be stereotyped according to its inhabitants. For example, it should not be assumed that in elderly care facilities, the color scheme should be in light tones or pastels. In fact, as one ages, the cataracts yellow, causing increased difficulty in determining the difference between light colors. Contradicting popular beliefs, bright colors are best for environments for the elderly. Secondly, using intense colors as accents adds contrast and can improve visual organization within a space. Thirdly, there are a few colors to avoid applying to large spaces in healthcare environments. Yellow-green, as mentioned before can give patients a sickly pallor. Also,

a bright, vibrant red can be perceived as a warning color and also can be reminiscent of blood.

There are many recommendations or suggestions for interior designers to follow when designing healthcare spaces. The following general guidelines developed by Mahnke and Mahnke in 1987 can help designers when programming color schemes for healthcare facilities.

STEPS FOR CREATING COLOR SCHEMES FOR HEALTHCARE DESIGNERS

1. Survey existing conditions, existing environmental issues, site orientation and lighting.

2. Determine the function of each area. Determine what tasks will be performed in each space and what type of people will inhabit particular units. For example, patients will typically spend less time in an ambulatory unit that in the ICU.

3. Determine the objectives of the client. Conduct interviews with staff to determine their needs and preferences of color. Conduct interviews with current patients to gauge their satisfaction or dissatisfaction with the current scheme and what they would change.

4. Consider religious/symbolic associations with color or ethnic/cultural concerns for that community.

5. Determine color schemes based upon two factors: aesthetics and function. From there, build the color scheme of the corridors as they typically set the tone for ancillary spaces such as patient rooms, exam rooms and nurses stations (Mahnke and Mahnke, 1987).

PRACTICAL APPLICATION OF COLOR

From my research, I learned a great deal of scientific knowledge in regards to color, helping to solidify my intuitive sense of color. So much of what interior designers do is based upon creativity, an intangible and unscientific element. However, important color decisions that may affect large numbers of people need to be rooted in sound knowledge. With this in mind, I created several color schemes for healthcare environments based upon facts I learned through my research. I also learned that there are two different processes for developing color schemes based upon creative and technical factors.

The first method for developing a color scheme that a designer may use is to first review general principals of color theory, keeping in mind the function of the space in consideration, and select colors seated in knowledge-based criteria. After the colors are chosen, the designer would review the selections based upon visual appropriateness or intuitive creativity.

The second method involves utilizing the creative element first. A designer would select a color set based upon what looks good or what a designer knows will work based upon experience or knowledge gained in the field. After a set is developed solely from creativity, the designer will judge it according to principles of color theory. The designer will add, remove and edit the color set until it satisfies both accepted rules of color theory and aesthetic principles.

Neither of these methods provides a better outcome than the other, or is more appropriate for choosing color schemes. It is up to the individual designer to determine which method is best for his/her style of work. I utilized both methods when developing

my color schemes in order to find which worked best for me. I found that using the first method, examining color theory before selecting any colors, bogged me down. Getting caught up in what colors were "right and wrong" hampered my creativity so that I was not able to choose colors at all. I found the best way was to assemble many colors, keeping in mind the look, function or effect I wanted to achieve, and then using the knowledge gained from my research, distilling the myriad of colors to cohesive palettes most beneficial to healthcare environments.

I created two color boards to visually represent color palettes suitable for healthcare interiors. A variety of finish materials were used, including paint, plastic laminate, wood, granite, and glass tile. These materials are to represent color only, and are not suggestive of what colors should be used on that particular surface. For example, I have selected an orange laminate sample, but I would not suggest covering every countertop in orange laminate. The samples are representations of color only. Board #1 represents four color palettes that work in tandem for a freestanding unit or a wing within a hospital. Each palette could work in a different functional area or space, but is still aesthetically pleasing as a whole. The color palette as a whole is based upon an analogous scheme, where all colors chosen are next to each other on the color wheel. Greens and blues, both used on the board, are located adjacently on the color wheel. This will create a non-threatening, yet inviting feel to an interior. I envision Palette A for consultation rooms or ancillary spaces, such as corridors, waiting areas or nurses stations. The base of the color set is warm greys, accented with medium to light green tones. The darker tones of green would be used for end walls or select accent walls; main surfaces, such as walls, floors and ceilings, would be kept in light tones or a wood finish for the floor.

Countertops, seating, office furniture and artwork are great places to add brighter colors without seeming too bold or intrusive.

Palette B would be utilized in a space centering solely on men's health. I challenged myself to choose a color scheme that was masculine in feel, but would not threaten any females that worked in the space. The idea was to create a space that would make both sexes feel comfortable, but would still give informational cues that men's health was the important focus in this space. I achieved this by balancing dark charcoal greys and teal blues with their lighter counterparts - beige, buff and turquoise. I also used a dark orange-red, as orange is a complement to the blues in the color palette.

Palette C could be used in any type of exam or treatment room throughout the facility. It uses combination of light creams, medium and dark mochas, bright aqua and medium wood tones to provide interest within the space, without using bold colors that may create feelings of chaos.

Palette D would finish the interior of a women's health department. The colors are bright and cheerful, but not too brash. Maple and red oak wood finishes keep the space from feeling to heavy, while bright white walls would give spaces a fresh, clean look. Waiting and reception stations, as well as exam and consult rooms, would have a main base of light or medium green, with bright accents of pale gold and coral. These warm colors may be an unexpected sight in a wing dominated mostly by blues and greens, but will give off a flattering light to patients' skin tones.

Unlike the first board, Board #2 does not group together four palettes to form a distinct facility. Each color set is separate from a whole. Both Palettes A and C could be found in pediatrics units within a hospital. Palette A uses bright colors that one would

expect to find within a children's hospital, however, it is important to note that all the colors used are not within the same value or intensity. Some children's wings consist only of bright primary colors or faded pastels. It is important to vary the hue, value and chroma to achieve the most interest within a space. I have selected bright, intense colors such as, yellow, melon and raspberry, but have balanced them with a less intense shade and tint of periwinkle. I believe this achieves a color set that is unified, but not boring. Likewise, Palette C achieves interest by utilizing differing values and chromas, but also double-complementary color scheme. This scheme is achieved by using two sets of complementary colors. In this scheme, they are orange and blue and yellow and purple. Using the double-complementary scheme provides a more interesting and sophisticated look to a hospital interior. This particular scheme may be more suitable for a pediatrics unit specialized for older children.

Palette B would work especially well for a family practice clinic, urgent care or other freestanding facility. The base of color palette resides in shades of cream and gradually darkening through shades of pale gold. To balance the lighter colors, shades of medium blue and a dark pink are used for accent colors. I believe this set of colors would be suitable for any type of general medicine practiced in these types of facilities. No colors are harsh or obtuse, and the palette is kept from being dull with the addition of *medium-toned accent colors.*

Finally, Palette D would be excellent for the main entrance or waiting areas of any clinical or hospital space. Varying tones of blue complement the terra cotta, giving a rich, warm, inviting feel. Using finishes like a multi-toned granite will lend an upscale look to an interior, while a mosaic of blue glass tiles will provide a punch of unexpected

color. Once again, blue and orange are complementary colors, and thus, provide a pleasing aesthetic in a color scheme.

CONCLUSION

Color is, indeed, a part of our everyday world. It pervades our sense of sight and is so commonplace, that we may not register its physical, emotional or psychological effects. The effect, however, is there. Whether we acknowledge colors or not, the brain is constantly processing color information, as evidenced by the phenomenon of color constancy, metamerism, simultaneous contrast and spatial dimension. This anatomical function of color can sometimes feel removed from the very real feelings and emotions that color can bring about. Color resides within our memories along with sights, smells and tastes. Through memory-associations, one can have strong emotional ties to color. These associations or tendencies towards certain colors can have marked physiological effects as well. While it has not been proved that one single color can raise one's heart rate or blood pressure, researchers believe that color (dependent on one's color preference) can affect vascular functions to a degree.

The color research and theories presented in this paper can provide a solid foundation for healthcare designers to use environmental color in a way that is not detrimental, but most beneficial to patients. When designing healthcare spaces, there are many factors that designers must be aware of, including how color can affect the image of the facility, wayfinding and signage, and the mental health and overall well-being of the patients in the facility. For patients confined to single spaces for long periods of time, designers must be aware of the risks of sensory deprivation and how it can be avoided.

Color is a variable in our life that should not be taken for granted. It should be enjoyed and appreciated. Color, however, should not be taken lightly, as a mere form of entertainment. Color research has not done enough to educate all designers in its potential in built environments. More research should be conducted to update past studies and research new questions that have come about with increases in technology. Lastly, it is important to remember that designers are not the only ones charged with using color in built environments. Everyone can and should express their preferences for color and how it benefits their everyday lives.

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