Aspects of Color

Frank Vodvarka, Associate Professor of Fine Arts, Loyola University Chicago

The study of color is complex, and made difficult by its variety of systems, which include the *aesthetic, psychological, physiological, associative, and symbolic*. Color has an extraordinary power to move us emotionally, leading the painter Emil Nolde to exclaim:

> Colors, the materials of the painter; colors in their own lives, weeping and laughing, dream and bliss, hot and sacred, like love songs and the erotic, like songs and glorious chorals! Colors in vibration, pealing like silver bells and clanging like bronze bells, proclaiming happiness, passion and love, soul, blood, and death.[i]

Designers have long recognized its importance to the design process. Not only does it qualitatively alter all other elements, but may in fact serve as its own subject, i.e. exert influence through its innate qualities. This was not always seen to be so; Leonardo da Vinci believed that light's purpose was to reveal form, and that color functioned only locally. Simply put, color served only in a descriptive role, on the assumption that an object's color is inherent. By the Baroque, this opinion had altered, as seen in its painting and decorative arts. Rembrandt's conception of color was that it might assume an independent existence, and in our own century the sculptor Chryssa said that light, color, and form are contiguous.This sentiment is distantly echoed by Emilio Ambasz in *The Architecture of Luis Barragan*:

> The extraordinary emotional effect of Barragan's compositions and the strong sensual qualities of his materials and colors cannot be guessed from his drawings or plans. The architectural richness of Barragan's dramatically sober architecture is based on a few constructive elements bound together by a mystical feeling, an austerity exalted by the glory of his brilliant colors. They pervade all the interstices of space, at once binding and separating artifact and nature. Paint is for him like a garment the wall puts on to relate to its surroundings.[ii]

Color has also become the subject of considerable investigation by *psychologists*. This has led to discoveries of the psychophysiological attributes of color, as well as an awareness of its socioeconomic dimensions. A word of caution: such studies have sometimes been misinterpreted and misused, leading to cosmetic palettes and "color coordinated" clothing. The psychologist Deborah T. Sharpe, in *The Psychology of Color and Design*, has referred to the writings of "color consultants" as having, "..for the most part included myth, purloined scientific works...and speculation."[iii] In short, while many color studies have been compiled by

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[i] 1. Attributed to Emil Nolde.

[ii] 2. Emilio Ambasz, *The Architecture of Luis Barragan* (New York: The Museum of Modern Art, 1980), 107.

[iii] 3. Deborah T. Sharpe, *The Psychology of Color and Design* (Totowa, New Jersey: Littlefield, Adams & Co., 1981), 55.

psychologists, few of them could be practically applied as they stand. Indeed, many data on color need to be gathered and analyzed before a methodology can be formulated. In part this may reflect what Dr. Rikard Kuller referred to in 1981 as, "...a gap between research on one hand and practice on the other, the infamous application gap."[iv] But it may equally reflect an uncertainty about the role color should play in design.

Color studies begin with the interaction of light and color, for without light we would observe no color, shape, or space. Our understanding of light and color was greatly aided by Sir Isaac Newton's discovery that white light contains all visible color. We see colors because wave-lengths of light vary; high energy light (400 on a nanometer scale) appears violet, while low energy light (approximately 700 nm) appears red. We see all light as white, except when standing in a space lit with colored light, either through colored glass windows or by virtue of particular lighting elements. Most surfaces have the capacity to absorb particular wavelengths; those not absorbed are visible to the onlooker. But what we mean by a particular color term may be quite different from what others mean. Sharpe points out that while the eye has the theoretical capacity to discriminate millions of different colors, there are only 150 discernible wavelengths in the spectrum. The average person can, with reliability, name only a dozen or so, and even these change with individual mood and association. In *Colour: Why the World Isn't Grey*, Hazel Rossotti states:

> But we must recognize...that colour is a *sensation*, produced in the brain, by the light which enters the eye; and that while a sensation of a particular colour is usually triggered off by our eye receiving light of a particular composition, many other physiological and psychological factors also contribute.[v]

These psychological and physiological factors, while open to interpretation, may determine our final perception of color. While the Commission Internationale de l'Eclairage (CIE) has devised an accurate system based on spectrophotometric measurements of color, such a system cannot predict individual human perception of a given color.

If the transmission of light represents one aspect of color, its reception by the human eye represents the other. As light strikes the retina, the light-receptive area at the back of the eye, it is recorded by rods (brightness receptors) and cones (color receptors). In bright light, the cones are operative, but as light dims, our color perception gradually decreases (beginning with low-energy hues) until there is insufficient light to see color at all. Then the rods take over, allowing a full range "night vision" in value alone. Curiously, we can accurately judge similarity of colors in different light intensities, a phenomenon known as *color constancy.* And, in certain circumstances, color has been "seen" in the absence of light; that is, electrical and mechanical stimulation of the optic nerve can induce color sensation, as can various chemical changes.[vi] It

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[iv] 4. Rikard Küller, *Non-Visual Effects of Light and Colour* Annotated Bibliography. Document D15:81 (Stockholm: Swedish Council for Building Research, 1981), 238.

[v] 5. Hazel Rossotti, *Colour: Why the World Isn't Grey* (Princeton, New Jersey: Princeton University Press, 1983), 16.

[vi] 6. Rossotti, *Colour: Why the World Isn't Grey*, 142.

has even been demonstrated that touch alone can discriminate parts of the electromagnetic spectrum, including color; this is known as dermo-optical perception (DOP), a theory based on radiant energy.[vii]

Other ways of sensing color via hearing, taste, and smell have also been reported; collectively, these alternative means are known as *synaesthesia*. Indeed, color sensation can actually be induced with black and white imagery alone. This, of course, assumes that one is not color-blind, as is the case with 6-9% of males and .8% of females. Perhaps most problematical for the designer are the afterimages composed of color complementary to the figure's color, and the variables in expressed preference of color combinations, which usually have a cultural component. The use of green in surgical operating rooms is, in fact, an effort to neutralize the constant exposure of the surgeon to the red-violet of human organ tissue so as to prevent spatial depth illusions. And the potential excitement of these same illusions in amusement park settings (which include dance clubs) may account for disorienting color combinations. And the assessment of particular colors may, in any case, alter in accordance with our age, emotional state, and socioeconomic status.

In the case of age, the alteration is physiological in nature: yellowing eye fluids account for a drop from about 85% acuity of blue at age 18 to 10% at age 69-80; and color acuity in general decreases. Changing emotional states are partly chemical, partly psychological: what we see and how we assess it. Accurate assessment of socioeconomic color choice is the goal of consumer product research teams. Sharpe reports that one department store chain that had success with a “gleaming black-and-white scheme in an affluent suburb failed dismally when they duplicated the scheme in a blue-collar suburb. This is consistent with the socioeconomic preference predictions of Wagner, who noted that black/white kitchen interiors were preferred by the top 3% of income levels, while avocado and gold were the preferred hues of lower-middle income families. Given all this, it is scarcely surprising that so many classifying systems have arisen, some purely aesthetic, and others based on information derived from the behavioral sciences.

Color is measured in *hue* (its character), *value* (or brightness), and *intensity* (or chromatic purity). These are commonly measures of reflected color, which is different from transmitted light. Thus the artist (or designer) speaks of red-blue-yellow as primaries, while the physicist (or lighting designer) considers red-blue-green as primaries. The addition of all three primaries in pigment form yields black (or dark grey, due to impurities in the pigment). An addition in light yields, as anyone familiar with a CIE "tongue diagram" knows, white.
The CIE diagram is good for two things: it graphically demonstrates why the three primary hues in light are red-green-blue (rather than red-yellow-blue) in quantitative terms, and why the EE point is so sought after by the designers of electric light sources. This also demonstrates one of the most problematical aspects of color - especially acute in theatrical set design - of combining projected light with reflective materials.It is a constant concern of designers to always show clients color samples in the light that will eventually illuminate those colors.

[vii]7. Richard P. Youtz, "Letters" in regard to paper read at the Psychonomic Society Meeting, 1963, 1964. *Scientific American*, June 1965, p.10.

From the pigment primaries are derived secondaries, orange-violet-green, and so forth. And from variations in this color wheel, coupled with alterations in value and intensity, theorists such as Ostwald and Munsell have derived the systems in use today. But both Ostwald and Munsell relied heavily on previous theorists; indeed, the roots of color theory may lie in Book Two of Leon Battista Alberti's *Della Pittura*, where he says that, "...the clear colours are always near other different darker colours. This contrast will be beautiful where the colours are clear and bright."[viii] The underlying theme in his discussion of color is its inter-relatedness, a common theme in Johann Goethe's *Theory of Colours* as well:

> When the eye sees a colour it is immediately excited, and it is its nature, spontaneously and of necessity, at once to produce another, which with the original colour comprehends the whole chromatic scale. A single colour excites, by a specific sensation, the tendency to universality. In this resides the fundamental law of all harmony of colours...[ix]

While Goethe's scientific conclusions have largely fallen before the wavelength theory of light, his observations about optical effects and emotional impact remain. His investigations provided a profound view of color, and the arrangement of color into the color wheel. While some of his observations about the nature of particular colors - that reds and yellows are invariably happy and expansive - ain't necessarily so, his color wheel has endured despite its inaccuracy in distribution. Critic John Ruskin echoed this inter-relatedness with a remark that is as accurate for designers as for artists, "Every hue throughout your work is altered by every touch that you add in other places."[x] The color wheel, in various configurations, became the standard method of visualizing color relationships; the Bauhaus designer Josef Albers noted that the situation was more complex, however, than a color wheel might suggest. In his *Interaction of Color*, he credits Schopenhauer with altering Goethe's six-part color wheel by differentiating it quantitatively, in order to equalize hues by noting relative brightness. Albers states, "...that certain constellations within a (color) system provide color harmony."[xi] Ostwald similarly discusses color harmony when he writes in his *Primer of Colors:*

> Experience teaches that certain combinations of different colors are pleasing, others displeasing or indifferent. The question arises, what determines the effect? The answer is: Those colors are pleasing among which some regular, i.e. orderly, relationship obtains. Groups of colors whose effect is pleasing, we call harmonious. So we can set

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[viii]8. Leon Battista Alberti, *On Painting*, trans. John R. Spencer (New Haven: Yale University Press, 1966), 84.

[ix]9. Johann Wolfgang von Goethe, *Theory of Colours*, trans. Charles Lock Eastlake (Cambridge, Massachusetts: The M.I.T. Press, 1982), 317.

[x]10. Rossotti, *Colour: Why the World Isn't Grey*, 105.

[xi]11. Josef Albers, *Interaction of Color* (New Haven: Yale University Press, 1976), 39.

up the postulate, Harmony = Order."[xii]

This comment was quoted somewhat critically by Johannes Itten in *The Elements of Color*, but he did agree with Ostwald on the desirability of arranging colors in a system using a color solid, with color defined by both hue and value. Munsell's theory of harmony was also based on the notion of common elements arranged by hue, value, and intensity in a spherical format so that the center of the sphere is the natural balancing point for all the parameters of color. Itten provides this rationale for his theories:

> The physiologist investigates the various effects of light and colors on our visual apparatus - eye and brain - and their anatomical relationships and functions... The psychologist is interested in problems of the influence of color radiation on our mind and spirit... Expressive color effects - what Goethe called the ethico-aesthetic values of colors - likewise fall within the psychologist's province. The artist (or designer), finally, is interested in color effects from their aesthetic aspect, and needs both physiological and psychological information.[xiii]

He concludes that, "Knowledge of objective principles is essential to the correct evaluation and use of colors."[xiv] It is interesting, in this context, to note that design firms (Skidmore, Owings and Merrill, for example) have employed artists for color selection.

Physiology / Psychology

Itten's insistence on the incorporation of *psychological* and *physiological* factors in the formulation of aesthetic systems is interesting. In fact, a color system for design might be structured in entirely psychophysiological terms, as in the color-preferences reported by particular audiences, or the effect a certain color has on affective response. Such uses of color are particularly persuasive when combined with a concern for light-sources, especially their reflectivity, brightness, and contrast. One of the first, and highly influential, works in the area of color psychology is by Faber Birren: *Color Psychology and Color Therapy*. This work was published in 1950, with a somewhat revised version appearing in 1961, and another edition in 1982. Birren had, from the early 1940's, been employed by both industry and government to manipulate interior color and light to increase production, improve efficiency, and enhance worker safety and welfare. The first edition consisted of an combination of psychological data, general observation, and mysticism, but he clearly was interested in physiology as well.

Thus, he notes in the revised edition (1961), "...as this book strives to show, the influence of color is by no means limited to the psychological realm; its direct biological and physiological

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[xii]12. Johannes Itten, *The Elements of Color*, ed. Faber Birren (New York: Van Nostrand Reinhold Company, 1970), 21.

[xiii]13. Itten, *The Elements of Color*, 12.

[xiv]14. Itten, *The Elements of Color*, 27.

effects are rapidly becoming more evident as new research data accumulate."[xv] The ultimate influence of his work may well be his insistence on *functional color*, represented in color-schemes utilizing tangible evidence rather than individual taste for their basis. He notes that the applied science known as *color conditioning*, begun in the 1920's, had long been concerned with the problems of *visibility, acuity*, and *ocular fatigue*.[xvi] These were, of course, the very problems that he was to solve, and that were common to factories, offices, hospitals, schools, and other public buildings, affecting people's efficiency and health.

Birren's ideas are referred to by most theories of color application that have followed. Indeed, his work on industrial color specifications, office lighting levels, and comparative brightness ratios have been acknowledged generally, although his ideas concerning therapeutic applications have been less successful. In their *Color and Light in Man-made Environments,* Frank H. Mahnke and Rudolf H. Mahnke note a debt to Birren, and state their premise:

> Color and light are major factors in man-made environments; their impact influences man's psychological reactions and physiological well-being...It is no longer valid to assume that the *only* role of light and color is to provide adequate illumination and a pleasant visual environment..[xvii]

This work not only discusses the effect, psychologically and physiologically, of our artificial environment, but offers codified, environment-specific advice. In fact, specifications for brightness ratios, task and ambient lighting types, and general illumination levels have been increasingly codified since 1940. One of Birren's tasks to ascertain and specify optimum light levels for industrial vocations. One of his best-known conclusions concerned brightness levels; if the task-illumination is kept constant while the ambient brightness level is raised, visual acuity improves. He notes, "This improvement will be gradual and constant *and will be at its maximum when the surrounding brightness is slightly lower than, or equal to, the task.*"[xviii]
On the other hand, if the ambient light-level exceeds that of the task light-level, performance rapidly diminishes. This led Birren to specify a *brightness ratio* of 3:1 as optimal for most tasks, although he thought that it might rise to a level of 10:1 without serious problem.[xix]

Unlike many in the lighting profession, Birren did not believe that high light intensity invariably led to good visibility. On the contrary, he maintained that ocular fatigue was more

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[xv]15. Faber Birren, *Color Psychology and Color Therapy: A Factual Study of the Influence of Color on Human Life* (New Hyde Park, New York: University Books, Inc., 1961), vii.

[xvi]16. Birren, *Color Psychology and Color Therapy*, 245.

[xvii]17. Frank H. Mahnke and Rudolf H. Mahnke, *Color and Light in Man-made Environments* (New York: Van Nostrand Reinhold Company, 1987), x.

[xviii]18. Faber Birren, *New Horizons in Color* (New York: Reinhold Publishing Corporation, 1955), 4.

[xix]19. Birren, *New Horizons in Color*, 5.

likely the result of strong brightness contrasts and task difficulty than of low levels of ambient lighting. Indeed, he pointed out that levels in excess of 35 footcandles can demonstrate only marginal improvements in acuity, illustrating this in a chart that relates footcandle ranges to brightness. Mahnke and Mahnke support Birren: "Glare, constant adjustment to extreme brightness differences, prolonged fixation of the eyes, and constant shifts in accommodation will tire eyes quickly, causing headaches, tension, nausea, and other disturbances."[xx]

An interesting finding of one illumination study is that when lighting approximates the spectral quality of natural sunlight there is less perceptual fatigue and improved acuity (Maas, Jayson, & Kleiber, 1974). This raises the issue of *seasonal affective disorder*, the symptoms of which include decreased physical activity and energy level, irritability, and sleep disorders.The effects of SAD are enhanced by the typical work environment, which depends, since the late 1940's, on flourescent lighting whose spectral composition differs markedly from natural light. Norman Rosenthal and associates found, however, that the use of full-spectrum light, in conjunction with time-alterations, tended to alleviate this condition.[xxi] The ability of full-spectrum lighting to alleviate SAD has accounted for its use in the workplace, particularly rest areas. High-CRI (color rendition index) lamps achieve a subjective clarity much higher than ordinary bulbs. Based on visual clarity studies, lighting engineers in Europe recommend a minimum of 85 CRI; no commonly-used flourescent source in the United States comes anywhere near that level, and a typical incandescent bulb has only a 42 CRI rating. A result is frequent eyestrain and its associated headaches.

F.Hollwich (1980) studied the effect of ordinary, albeit strong artificial light, and concluded such illumination explains the agitated mental and physical behavior of children who stay at school all day in such conditions. On the other hand, it has been demonstrated that the use of full-spectrum lighting decreased hyper-active behavior in school children (Mayron, Ott, Nations, & Mayron, 1974). Mahnke and Mahnke maintain that full spectrum lighting should be used in classrooms, libraries and gymnasiums, but not necessarily in short-term places like corridors. The use of full-spectrum lighting in employee break areas is often coupled with highly saturated yellow wallpaint being used to raise adrenalin levels. Mahnke and Mahnke document the various studies made to determine color preferences, their cultural associations, and the affective responses particular colors elicit. Using this data, they have assembled color-scheme types for particular environments. The colors suggested by the authors for a hospital maternity room (dark green floor, pale green ceiling, greyed pink walls, and pale yellow frieze), for example, have been chosen for their acceptability by patients and nursing staff, and general effect on emotional state.

It is certainly true that the sheer quantity of reliable information about the effects of color has increased throughout the past half-century. For example, in young people between the ages of six and seventeen, it has been shown that females prefer warm colors, and males the cool

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[xx]20. Mahnke and Mahnke, *Color and Light in Man-made Environments*, 40.

[xxi]21. Mahnke and Mahnke, *Color and Light in Man-made Environments*, 53.

ones.[xxii] On the other hand, as they grow older, both sexes lose interest in intensity of colors and gain interest in hue.[xxiii] While children are at their peak for color-dominance at age four and a half, they turn to form-dominance by age six (and throughout adulthood);[xxiv] this is accompanied by a life-long interest in the color blue.[xxv] An interesting corollary to this are the preferences by older adults (over sixty-five) for bright primary, secondary, and tertiary colors over pastel shades; this stands in sharp contrast to popular institutional opinion.[xxvi] A developmental color scheme for the first 2-3 years of life for children would be saturated red, blue and yellow (with a de-emphasis on the yellow, as it causes restlessness). This would aid in synapse development. It is ironic that almost the same scheme benefits the elderly.

Studies indicate that colors have been identified in conjunction with temperature, weight, smell, sound, and even taste (as in variations of red, which aids in the sensation of sweetness).[xxvii] Thus a study carried out at O'Hare found that color influenced people's perception of relative sweetness, in this case of candy. The brown and pink candies were judged quite sweet, while the blue and green candies were thought to be without any sugar at all. This also explains the relative success of pink on bakery boxes. In fact, people tend to become slightly disoriented in red light, as well as experience an increase in appetite. Coupled with the increase in adrenalin produced by yellow, saturated red-yellow combinations in light and paint are ideal for fast food places - and are used by virutally all of them. Red is also used in places that serve alcohol, although the tendency for this color to increase aggression may be less than desirable. Recent data (Porter and Mikellides, 1976) indicates that blue extends our sense of time; thus blue is a poor choice for children, whose sense of time is already extended. The data on temperature-perception is reliable; studies consistently indicate that a blue room is perceived to be three-four degrees cooler than a red one (Porter and Mikellides, 1976); and vice versa (Clark, 1975).[xxviii] Thus a 6-8 degree swing in perceived temperature is obtainable through painted surfaces alone. Recent litigation in California demonstrates that paint color will be an increasingly important design factor in the future.

A major difficulty in attempting to predict how an audience will react is that of cultural relativity. Studies have shown, for example, that while Japanese and Americans may agree on the affective measures of color (e.g., that warm is more exciting), they disagree in their

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[xxii]22. Sharpe, *The Psychology of Color and Design*, 18.

[xxiii]23. Sharpe, *The Psychology of Color and Design*, 19.

[xxiv]24. Sharpe, *The Psychology of Color and Design*, 9.

[xxv]25. Birren, *Color Psychology and Color Therapy*, 176.

[xxvi]26. Sharpe, *The Psychology of Color and Design*, 136.

[xxvii]27. Sharpe, *The Psychology of Color and Design*, 131.

[xxviii]28. Mahnke and Mahnke, *Color and Light in Man-made Environments*, 18.

evaluation of such colors.[xxix] Another complicating factor may lie in our favoring a color in some situations but not in others, or associating a particular color with an experience. The data on human color-preferences are quite consistent, however. Studies (Eysenck, 1941; Guilford and Smith, 1959) have indicated that people prefer colors in the following order: blue, red, green, violet, orange, and yellow. Gender differentiation is minor, with men tending to slightly prefer blue to red, and women yellow to orange, although neither preference is sufficient to offset the above order for the general population. Indeed, this order is consistent even across lines of age and national origin. Such consistency raises intriguing questions about whether such preferences are learned or innate. In fact, J.P.Guilford has stated that this commonality of color preferences, "...probably rests upon biological factors, since it is hard to see how cultural factors could produce by conditioning the continuity and system that undoubtedly exist."[xxx]

When the reactions stop being culture-bound or memory-associated, they may be crossing into the physiological realm. Red light has been shown to enhance functions of the autonomic nervous system, evoking more tension, excitement, and hostility than the color blue (Gerard, 1957). For that matter, red light seems to produce anger and anxiety in infants and the mentally ill, and tests at Yale University indicated that the color red tended to detrimentally affect such mental activities as problem solving, decision making, and social conversation.[xxxi] Additionally, red light has been shown (in certain subjects) to increase bodily activity and extreme emotion, while blue light is physically calming.[xxxii] The effects of transition from the tranquilizing atmosphere of an essentially blue space, to one in which warm hues dominate may be experienced in Arata Isozaki's Palladium in New York City, although whether it was so intended is not clear. Certainly the notion of passing from the "deep blue sea" to a space of "blinding luminosity" suggests it.

Many of these psycho-physiological studies remain speculative, and influenced by the difficulty in separating learned versus innate responses. But it is clear that the psychological and physiological aspects of color will become prominent in design decisions. This not only raises questions about the potential conflict with color's traditional role as an expressive device, but may also challenge many of our views of color based on custom and symbolism.
Custom is simply the cultural stamp of approval given a particular color. While these colors may appear to be sacrosanct, historical analysis usually reveals a set of socioeconomic realities that were at one time operative. The Swedish use of deep red paint on the exterior of houses is endemic; the art historian Erik Lundberg believes that it started in imitation of the red brick manor houses of the wealthy. Paint colors have historically been responsive to economic and cultural trends, as in the 19th century use of white paint to indicate wealth.

Symbolism is, in some sense, an outgrowth of association and custom; colors forever

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[xxix]29. Sharpe, *The Psychology of Color and Design*, 41.

[xxx]30. Sharpe, *The Psychology of Color and Design*, 149.

[xxxi]31. Sharpe, *The Psychology of Color and Design*, 86.

[xxxii]32. Rossotti, *Colour: Why the World Isn't Grey*, 209.

associated with a particular phenomenon, and sanctified by time and usage. They are the colors of our uniforms, social and religious icons, and institutions. They are the colors of our flags, although various studies referred to by Sharpe indicate that even these choices are the, "...reflection of color preferences within the social-psychological context of traditions and aspirations."[xxxiii] She found that the flags of the northern tier of states relied on cool, low-intensity colors, a heritage of the northern European Protestant sensibility that settled the plains. Southern states, on the other hand, used warm, intense colors. They are difficult to use (i.e., transfer meaning from one context to another), but such was attempted in the vaulted golden ceilings of 190 South LaSalle Street in Chicago, designed by Burgee/Johnson. Here the historical trappings of one eminent institution - religion - have been transferred to another - commerce. Manipulation of such symbolism is always risky, however, as societies tend to invest symbols with vastly more passion than the more prosaic realities.

The factors that make up a study, and application, of color are many; and they are more complex by the difficulty in knowing color's role in particular situations. This may account for the fact that despite more objectified (and reliable) information available to designers from studies in psychology, little finds its way into actual design solutions. There is increasing information available, however, on the role of light and color in that 20th century phenomenon, the office environment. For the sake of this paper, some of that information can be divided into three distinct areas: graphics, interior environment, and personal dress.

The term *graphics* immediately suggests both internal communication devices and the advertising that supports product sales. It is ironic that the color yellow - used for legal pads, photocopy paper, and yes - *post-its* - should have a generally poor effect on our perception of, and reaction to, the information inscribed on them. Studies have shown that error rate for transcription rises when yellow paper, or even #3 yellow pencils, are used. (The reason, incidently, for the paper being dyed yellow has to do with the higher cost of white paper.) The color yellow should only be used when extreme urgency is meant, and never in external missives, as it invaribly communicates a *cheap* quality. Color is, however, extremely effective in product advertising. A study by Starch found that color ads draw half again as many inquiries as black and white. Warner and Franzen found that, while color is not particularly significant in promoting a new product, it enhances and maintains the image of known products. (Hence the importance of copyrighting color.)

Some aspects of the *interior environment* have been dealt with previously; the important issue is that the color on the room surfaces should not be taken casually. It affects worker productivity, absenteeism, and interpersonal communication - all vital issues. And as color is so vital, it is certain to be the subject of litigation. This will not be easy. Not only are there variants in terms of age and cultural background, but in gender as well. In fact, there is substantial evidence that males and females vary in their perception (and approval) of color based on synapse differentiation, sometimes referred to as *opponent coding theory*. Paint manufacturers have developed two series of paints based on this phenomenon. And the Luscher test, long a staple of upper-level hiring practice in Europe, may be coming to the United States.

[xxxiii]33. Sharpe, *The Psychology of Color and Design*, 33.

The issue of *personal dress* is, in some ways, the most sensitive as americans tend to regard these sort of choices (within a general code) as personal. That is, color choices in clothing are seen as personally expressive. Some theorists (Wagner, for example) believe this attitude to be a mistake, that our color choices should be instrumental. From this point of view, what counts is how people react to what we do and say - which can be aided by color choices. Studies show that approximately 80% of the hiring decision is based on appearance factors, and that 65% of that involves clothing color. Brown and, to a large degree, green seem to inspire confidence, and at least some designers use this fact for intake interviews. Black and deep blue clothes suggest authority. And so forth. What is interesting about this view is that it regards color as a tool in achieving ends, rather like a resume or clothing-type.

And there are still other issues surrounding color, from its use as both a diagnostic and therapeutic device in medicine to its function as a part of international communications. But they are too numerous and complex to fit within the scope of this modest paper.

Endnotes