COLOR AND ITS PSYCHOLOGY

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How would the world be without colors? Or what would happen if everything in the world were the same color? Not many among us ponder upon such possibilities. We are so inclined towards color that we cannot envisage our lives without them. Sometimes even our dreams are so colorful that they seem indubitable. “The Night Circus” by Eric Morgenstein is a book that makes us anticipate a world that has no colors in it and diffusely associate our emotions to it. Color-emotion relationships are so common that colors have been used as synonyms to emotions by many. Taylor Swift (an American singer) in her song “Red” has followed similar ways to express her emotions,

“Losing him was blue like I’d never known

Missing him was dark grey all alone

Forgetting him was like trying to know somebody you never met

But loving him was red.....”.

Does this mean that people who are color blind lack these triggers to emotions? Or do they have different triggers to emotions? Whatever be the reason we now have several examples before us that demonstrate similar types of emotions in a healthy and a color blind individual. For example, both Mark Twain (famous author) and Mark Zuckerberg (the creator of Facebook) have played with different levels of emotion in their respective creations in spite of being red-green color-blind. Thus the abstract

linkages provided to colors are not just visual but a combination of physical (visual) and physiological events.

Those among us, with normal color vision experience a wide range of chromatic palette that may even reach infinite possible combinations, thereby removing all limits to the number of colors we can imagine. Thanks to our eye which consists of two types of photoreceptor cells, the rods, and the cones. Among these photoreceptor cells, the cones are the ones that have the ability to view and distinguish colors. There exist three types of cone cells, the red, the green and the blue. Although only three colors of cones are present in the human eye, we can identify and differentiate the colors of different hues and wavelengths. This is achieved by the human brain which reconstitutes and perceives these colors. In the 1930s it was well established that a human being with healthy color visions can distinguish between 200 shades of a single color. So ideally a human being should be able to view 8 million shades of all the colors taken together (200 X 200 X 200) using the L*a*b coordinates, where L indicates lightness, a is the red/green coordinate and b is the yellow/blue coordinate (Lab/LCH Coordinates). However, a realistic approach requires the sensitivity of both the eyes to be exactly the same for a person to view 8 million different colors, which is rare. Hence, whatever be the scope of colors viewed by different persons, each color is ultimately perceived in the brain, where they are further linked to emotions.

BACKGROUND OF COLOR PSYCHOLOGY

The scholarly link between color and psychology was first propounded by the German poet and polymath Johann Wolfgang von Goethe in the 1840s. Goethe put forward speculation on, the influence of color perception on emotional experience, in his classic work "Theory of colors". However, this speculation was solely based on intuitions and lacked experimental evidence. Later, there appeared a categorization of colors into 'plus' and 'minus', where plus colors (**yellow, red-yellow, yellow-red**) were thought to induce positive feelings and minus colors **(blue, red-blue and blue-red**) were thought to induce negative feelings (Eliot and Mayer, 2014). The positive feelings included that of warmth, pleasure and lively ones, while the negative feelings were those of anger, anxiety, and restlessness. Goethe's intuitive presumptions were experimentally evidenced in the twentieth century by psychiatrist Kurt Goldstein, where he exemplified the effects of colors on the physiology of a person through his clinical observations. These physiological effects were displayed by changes in the cognitive focus, emotional behavior, and motor reactions. Goldstein's interpretations were restructured and put forth in terms of wavelength by Nakashian who proposed that longer wavelengths are thought to be experienced as arousing or warm and shorter wavelengths are thought to be experienced as relaxing or cool (Nakashian, 1964). Ott, in 1979 reported similar observations, where he related the physical and physiological changes that are demonstrated in the behavior of a person, to endocrine (hormonal) functions. He proposed that **orange** and **pink** colors have an endocrine-based weakening effect on the muscles and **blue** color has an endocrine-based strengthening effect on the muscles. Likewise, several inferences have been posited in the pre-twenty first century that linked colors hypothetically to behavior without having any experimental or theoretical considerations.

COLOR PSYCHOLOGY - EMPIRICAL EVIDENCE

The twenty-first century witnessed varying experimental evidence on the psychological linkages of color. Initial findings were related to the cognitive and motor performances of an individual. The prominent finding among them was the "red effect" which outlayed **red** color as having a negative impact on challenging tasks. It was proposed that red color enhanced the production of testosterone in males and was responsible for their aggressive and dominant character (Hill and Barton, 2005). Several studies have related the "red effect" to the performance of an individual in cognitive tasks (Friedman and Forster, 2010; Larionescu and Pantelimon 2012, Elliot and Aarts, 2011; Williams et al., 2011; Payen et al., 2011) or categorized the outcome of this effect based on difficulty levels of the tasks performed (Kuller et al. 2009).

Ideas on the emotional linkage of colors in the twenty-first century were so diverse that a single color was attributed to contrasting emotions by different people. Boyatzis and Varghese reported that people attach colors like **sky blue, light green** with positive emotions like joy, surprise, happiness, etc. (Boyatzis and Varghese, 1994). According to Hemphill people attach **dark** shades or hues with negative emotions. Further, Boyatzis found that bright colors are mainly attached to positive emotions and dull colors are associated with negative emotions. Clifton projected that lifting a black colored box seemed heavier compared to lifting a green colored box. In a similar study, Akers et al 2012 reported that viewing green color during cycling reduced exertion.

A conceptual theory of color was postulated by Meier and Robinson (2005) and Meier(2015). This theory proposes that abstract concepts are thought about by people in concrete terms which are based on perceptual experience. In other words,

people use metaphors in order to understand and operate their social world (Lakoff and Johnson, 1999). Hence an angry person has a red face which is why it is thought that seeing red awakens anger and seeing the light and being in the dark are metaphorically linked to positive and negative emotions or experiences respectively. These metaphor linkages have affected social understanding in judgments relating to morality (white is pure) and formulation of stereotypes (black is evil). Some experiments have yielded evidence suggesting that viewing **blue or green** may be particularly beneficial for creative performance (Lichtenfeld et al. 2012, Mehta and Zhu 2009) others have suggested that **yellow** color seemed detrimental for cognitive tasks (Kumietal, 2013) but these questions have received only a modicum of empirical attention. Thus there wasn't a clear hypothesis that could be formulated to a theory in the field of color psychology.

Thus, psychologically different colors may give different emotional responses. These emotional responses are an outcome of different hormones released. Additionally, it should be known that multiple external and internal factors are synchronously acting as triggers to these emotions and that no emotion can be directly linked to any single hormone.

PSYCHOLOGY OF EMOTIONS

Psychology emerged as a scientific discipline in the 19th century when the experimental methods from neurology and physiology were applied to search for the physical basis of the mental categories posited by faculty psychology, which views the mind as a collection of independent modules. A key finding of Kober et al, 2008 suggests that medial frontal areas are more closely associated with activation of limbic areas (thalamus, amygdala, hypothalamus) than their lateral counterparts and that dorsomedial prefrontal cortex may play a particularly important role in the cognitive generation of emotional states (Fig.1.). The limbic system is the major primordial brain network underpinning emotions.

These emotional responses can be linked biologically to the variations in the amounts of hormones produced/present in the body. Colors are just triggers to these variations. The physiological and psychological responses of humans to colors can be explained as the changes in blood pressure, pulse rate, and hormonal activity.

The hormones that are related to positive or happy emotions are Dopamine, Serotonin, Oxytocin, and Endorphins. Dopamine is a neurotransmitter that is associated with pleasurable sensations along with learning, memory, motor system function and more. Serotonin helps regulate one’s mood as well as sleep, appetite, digestion, learning ability, and memory. Oxytocin is essential during child-birth and can also promote trust, empathy, and affection. Endorphins are endogenous opioid neuropeptides and are produced as a response to stress. These are also natural pain/stress relievers.

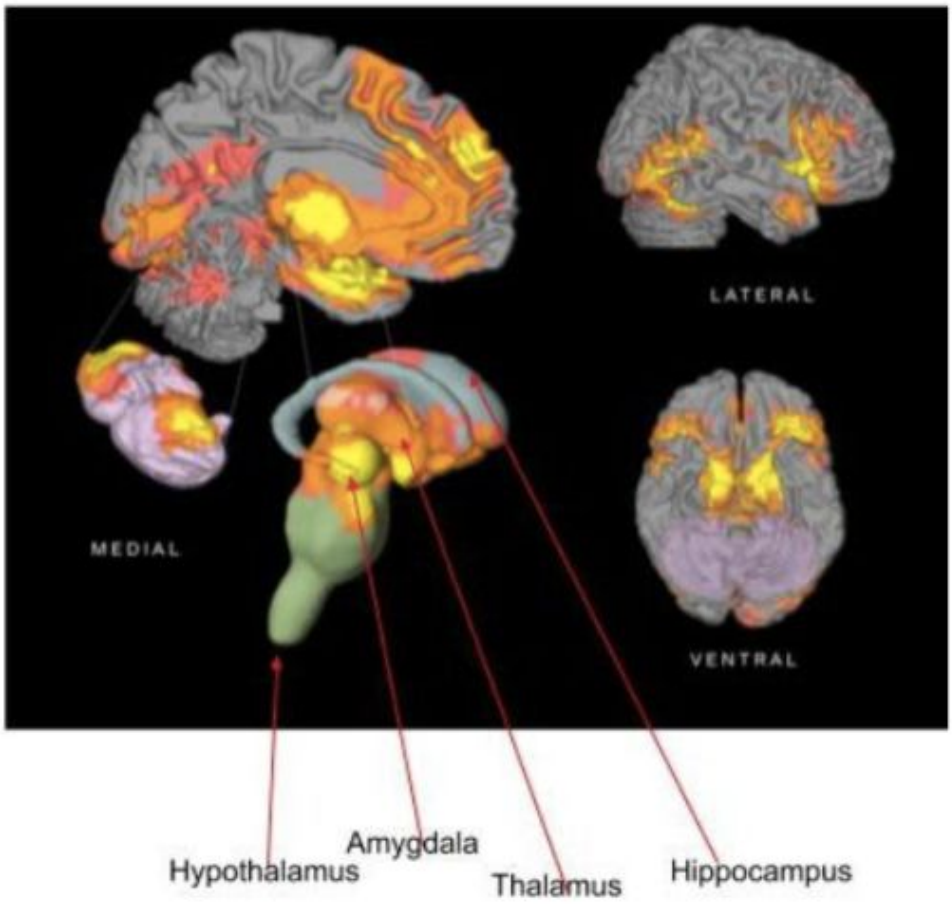

Fig.1. **The Emotional Brain:** A visual representation of increases in neural activity during the experience or expression of emotion (image taken from Kober et al. 2008). No activation was specific to any emotion category. On the left, medial view of the left hemisphere, with the cerebellum (in purple) plus subcortical regions. On the right, lateral view of the right hemisphere (the outside surface) again with the front of the brain pointing right. The bottom right is the ventral view as if you are looking at the brain from the bottom. The portions in the limbic system shown in orange and yellow color are the regions that get activated during the experience/expression of emotion.

COLOR PSYCHOLOGY IN OTHER RESEARCH AREAS

It is an unquestionable fact among marketers and graphic artists that consumer behavior is highly influenced by color (Paul & Okan 2011). In this regard, blue seemed to be a highly positive color and blue colored websites and stores are marked down as more pacifying, less congested, and more trustworthy (Gorn et al., 2004; Alberts and Geest, 2011; Lee and Rao, 2010; Yuksel, 2009). Color criteria have turned up for certain categories of the product, and deviations from these criteria have proved favorable in some categories such as entertainment but unfavorable in others such as fast food, where there is either a dominant market player or has public emotions attached to it (Labrecque and Milne, 2013). However, it has been considered that all these effects may arise due to perceptual responses that are independent of color associations.

Finally, color psychology is an exclusively intricate area of inquiry (Kuehni, 2012; Fairchild, 2013) that is only beginning to come into its own. Findings from color research can be provocative and media-friendly, and the public (and the eld as well) can be tempted to reach conclusions before the science is fully in place. There is considerable promise in research on color and psychological functioning, but considerably more theoretical and empirical work needs to be done before the full extent of this promise can be discerned and, hopefully, fulfilled.

References

- Akers A, Barton J, Cossey R, Gainsford P, Grifn M, Micklewright D. 2012. Visual color perception green exercise: positive effects of mood on perceived exertion. Environ. Sci. Technol. 46:8661–66

- Boyatzis C. J., and Varghese R. (1994). Children's emotional associations with colors. The Journal of Genetic Psychology: Research and Theory on Human Development, 155(1), 77–85

- Clifton, (2006) Basic needs in a new light- a colourful diagnosis. International journal of Reality therapy, 26(1), 18-19

- Elliot A. J, Aarts H,. (2011). Perception of the color red enhances the force and velocity of motor output. Emotion 11:445–49

- Elliot A. J, and Maier M A., (2014) Annual Review in Psychology 65:95-120

- Fairchild M. D. (2013).Color Appearance Models, 3rd Edn. New York,NY: Wiley Press.doi:10.1002/9781118653128

- Friedman R.S., Forster J. (2010). Implicit affective cues and attentional tuning: an integrative review. Psychol. Bull. 136:875–93

- Hemphill M. (1996) A note on adults colour emotion associations. Journal of Genetic psychology, 157. 275-281

- Hill RA, Barton RA. (2005). Red enhances human performance in contests. Nature 435:293

- Kober H., Barrett L. F., Joseph J., Bliss-Moreau E., Lindquist K. A., and Wager T. D. (2008). Functional networks and cortical-subcortical interactions in emotion: A meta-analysis of neuroimaging studies. Neuroimage, 42, 998-1031

- Kuehni R. (2012). Color: An Introduction to Practice and Principles, 3rd Edn.

NewYork,NY:Wiley.doi:10.1002/9781118533567

● Kuller R, Mikellides B, Janssens J. (2009). Color, arousal, and performance -a comparison of three experiments. Color Res. Appl. 34:141–52

● Kumi R, Conway C M, Limayem, Goyal S. (2013). Learning in color: how color and affect inuence learning outcomes. IEEE Trans. Prof. Commun. 56:2–15

●Lab/LCHcoordinates (https://sensing.konicaminolta.us/blog/identifying-color-differences-using-l-a-b-or-l-c-h-co ordinates/)

● Labrecque LI, Milne GR. (2013). To be or not to be different: Exploration of norms and benets of color differentiation in the marketplace. Mark. Lett. 24:165–76

● Larionescu A M, Pantelimona M. (2012). The inuence of colour on the efcacy of basketball throws. Ann. Univ. Galat¸i1452:82–85

● Lichtenfeld S, Elliot A J, Maier M A, Pekrun R. (2012). Fertile green: Green facilitates creative performance. Personal. Soc. Psychol. Bull. 38:784–97

● Mehta R, Zhu R J. (2009). Blue or red? Exploring the effect of color on cognitive task performance. Science 323:1226–29

● Nakashian J S. 1964. The effects of red and green surroundings on behavior. J. Gen. Psychol. 70:143–6

● Paul S and Okan A., (2011).Response to colour: literature review with cross-cultural marketing perspective.Int.Bull. Bus. Adm. 11:34–4

● Payen V, Elliot A J, Coombes S A, Chalabaev A, Brisswalter J, Cury F. (2011). Viewing red prior to a strength test inhibits motor output. Neurosci. Lett. 495:44–48

● Williams C K, Grierson L E, Carnahan H. (2011). Colour-induced relationship

between affect and reaching kinematics during a goal-directed aiming task. Exp. Brain Res. 212:555–61