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Light Effects on Personality Transformation

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ABSTRACT

This study found that the effect of illuminance and color temperature on creative thinking and analytical skills is not systematic, suggesting that different working environments should provide different artificial lighting settings based on their primary skill requirements. The findings of this study can contribute to the effectiveness of the working environments. As mood shifts can affect the creative ability of space users and impact their behavior, mood swings, controlled by illuminating the environment can be beneficial and crucial in work performance. This study proves the enhancement of positivity in the work environment. The knowledge of employees and their comprehension of the complex interactions and creative performance are inevitably regulated by the lighting parameters. This study mentions natural light but also covers the significant role of artificial light. However, in a practical working environment, we cannot neglect the effects of daylight. Further work on the progressive combination of artificial light and natural light will be carried out to establish more practical results. The outcome of the present study shall be validated in future experiential determinations with participants of larger sample size, balanced gender (Knez 2001), measured in different works, among certain age groups to improve the general implications.

Introduction

It is the unqualified result of all my experience with the sick that, second only to their need for fresh air, is their need for light; that, after a closed room, what hurts them most is a dark room and that it is not only light but direct sunlight they want. — Florence Nightingale, 1860, p.47

In these studies, direct sunlight entering the room – particularly in the morning – proved effective in decreasing the length of stay for depressed patients in psychiatric units (Beauchemin & Hays, 1996; Benedetti et al., 2001). Spinal surgery patients reported lower levels of experienced pain and stress in more sunny hospital rooms (Walch et al., 2005). Patients treated for a myocardial infarction showed faster recovery and lower mortality in more sunny rooms (Beauchemin & Hays, 1998, in a manuscript aptly titled 'Dying in the Dark').

The study of light and its effect demonstrates the eminence of curative and healing properties of natural and artificial light in cases of physical and mental health disorders.

''The application of lighting in human health has caused recent breakthroughs in light exposure related to pathology, therapeutic strategies, molecular changes, and more. Finally, we also discuss potential future developments and areas of application in the aspects of developing the personality of individuals. (Muqing Liu, et al 2024)

Though the overexposure and harmful effects of light are of grave concern, researchers endeavor to enable the maximum benefits of light in the positive development of psychology, deterring depressed mood, and negating the probabilities of its adverse effect on the overall well-being of an individual.

METHODOLOGY

The methodology followed in this research is comparison of different available data and experimental figures of successful application on groups of people with different intensities of light.

DISCUSSION

Recent research showed a consistent preference for brighter and sunnier views, even when controlling for the content of images (Beute & de Kort, 2012). It has been asserted by the scientists that development with regards to areas like better vitamin D synthesis, circadian regulation, DNA damage, oxidative stress, skin light models for cure of cancer, are concerns of meticulous regulation of light and its intensity. Yet recent research showed a consistent preference for brighter and sunnier views, even when controlling for the content of images (Beute & de Kort, 2012). As such, sunlight and daylight can improve satisfaction, improve mood, and induce positive emotions. In turn, mood and emotion, as core elements of subjective wellbeing have been related to health in the domain of positive

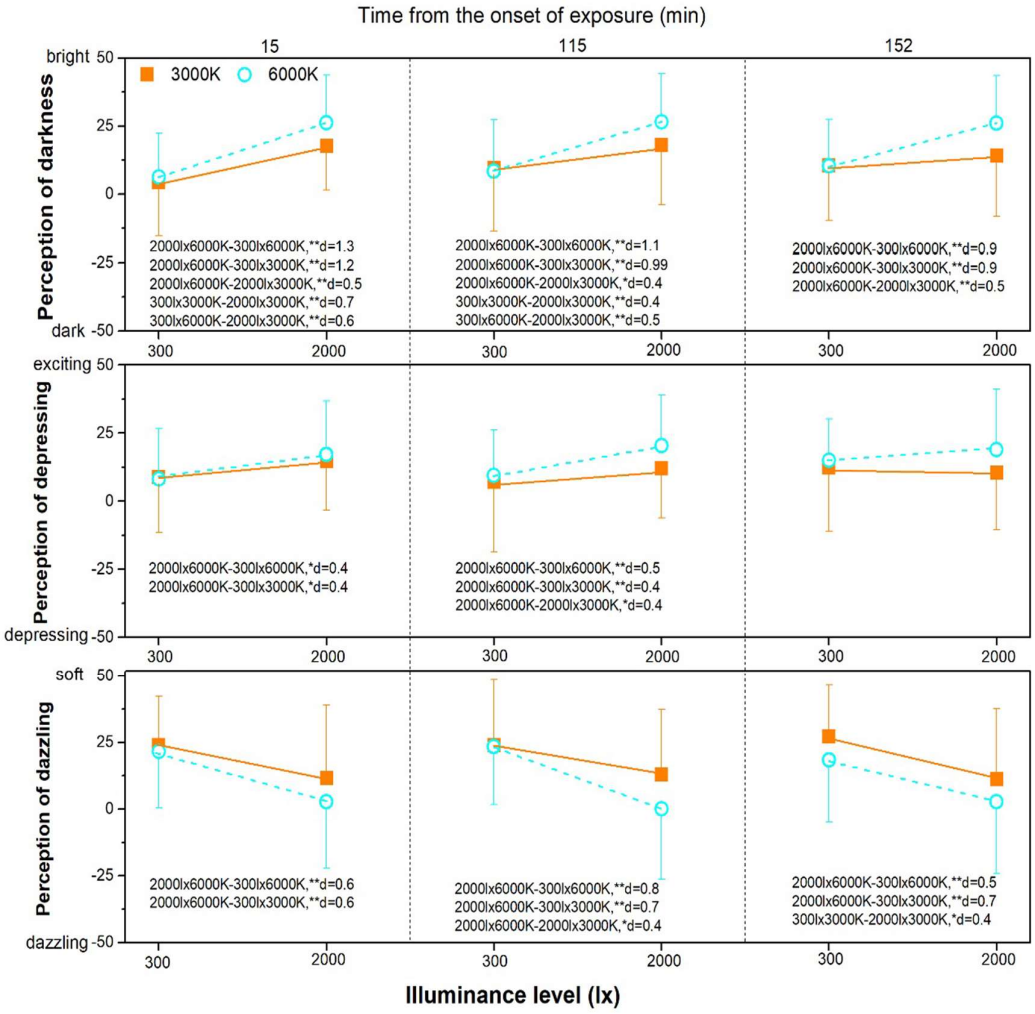
psychology.Yvonne De Kort, 2013)

The typical definition of creativity stated by many researchersis the ability to produce useful and novel ideas in all fields (Woodman et al. 1993; Amabile et al. 1996; Stein 2014). Amabile et al. (1996) stated that physical environments thatare engineered to be cognitively and perceptually stimulatingcan enhance creativity. Researchers have attempted to makean inventory of the key components of a creativity fosteringtangible environment (McCoy 2005; Dul and Ceylan 2011;Sailer 2011). McCoy (2005) categorized these components into spatial organization, views, resources, ambient conditionsand architectonic details. Landry (2012) identified 9 most encouraging factors that support creativity in work place, adding personal items, nature, furniture and artificial lighting(Landry 2012). Dul and Ceylan (2011) listed 12 attributes of a creativity enhancing work environment. Artificial lighting parameters, including lighting illuminance (ILL) andcorrelated color temperature (CCT) are identified as two factors that can support creativity in the workplace (Dul and Ceylan 2011;

Landry 2012) Lighting illuminance and color temperature have been shownto affect mood, although the nature of the mood shiftscreated by different light combinations are still subject to debate (McCloughan et al. 1999; Edwards and Torcellini 2002; Hisieh 2015). Baron et al. (1992) observed that dim warm light enhanced positive mood, while dim cool and bright warm light induced more negative affect. The findings of that study are consistent with the Kruithof curve (Kruithof1941), i.e., a low or a high color temperature correspondingto a low or high level of illuminance is empirically assessed as being pleasing or natural. McCloughan et al. (1999)examined a narrower illuminance level.

The mood states (not specific to lighting) have been found to be strongly linked to creative outcomes. Studies indicate that positive and negative mood correlate in distinct ways with different creativity-related skills. Estrada et al. (1994) reported that positive mood improved creative problem solving and the sources of practice satisfaction. Abele-Brehm(1992) found that those with a positive mood produced moreideational Fluency on verbal creativity tasks. Subramaniamet al. (2009) observed that participants higher in positive mood solved more problems, and specifically more with insight, compared with participants lower in positive mood.Functional magnetic resonance imaging (FMRI) analysisindicated that positive mood states altered preparatory activity in the anterior cingulate cortex, biasing participantsto engage in problem processing that is conducive to solvingproblems with insight. On the other hand, Kaufmann and Vosburg (1997) observed that a positive mood led to poorer creative problem-solving performance, while an induced negative mood significantly facilitated creative problem- solving performance. For the figural creativity task, Zenasni and Lubart (2002) found that the participants were more fluent when their emotions were negative and relatively intense. Flexibility of ideas and fluency are mood-repair strategies that help people return to their neutral mood. Studies on the non-visual or non-image forming (NIF) effects of light have shown that light affects the brain activity, including physiological impacts (hormones production, alertness, arousal) and cognitive or creative abilities such as working memory, attention, problem solving, etc. (Mukae and Sato1992; Stevens et al. 2007). Although these investigations have provided evidence that the two key lighting factors are illuminance and correlated color temperature, their findings remain conflicting. Some studies were in favor of elevated illuminance levels or bright light as beneficial factors for cognitive abilities, including working memory and attention(Phipps-Nelson et al. 2003; Smolders and de Kort 2014; Huiberts et al. 2015), while others demonstrated opposite effects of high illuminance on the same abilities (Min et al. 2013; Leichtfried et al. 2015). Some researchers reported that dim light supported the generation of new ideas and darkness enhanced the feeling of freedom from constraints and reduced inhibition, which promoted creative performance(generation of creative uses, originality in imagination, andinsight problem solving) (Steidle and Werth 2013). Althoughhigh CCT light, which is rich in blue waves, has positive effects on alertness and the treatment of psychological disorders, its NIF effects are still controversial. Daylight exposure to high CCT was confirmed to be advantageous for cognitive abilities and reduction of fatigue (Hawes et al.2012; Ferlazzo et al. 2014) as well as sustained attention (Keis et al. 2014). However, Weitbrecht et al. (2015) observedopposite results when they investigated the effect of color temperature on creativity and concentration. They tested three color temperatures (3000 K, 4500 K and 6000 K) under a high illuminance level of 1000 lx. The results showedcreativity was better under low CCT light (3000 K) thanunder higher CCT (4500 K, 6000 K). The above studies suggest that the effect of illumination and CCT is probablydetermined foremost by the nature of the cognitive skill.
This research presents information from the above studies on lighting, mood and creativity. The first key point summarizedin Table 1 is that ILL and CCT have interactive effects on mood, but few studies investigate the consequences of moodchange on creativity. Second, several studies confirmed thatcreativity could be strongly linked to the mood state of the subject, but the mood state of subjects in these studies was not induced specifically by lighting parameters. Finally, thesestudies observed the effects of lighting on creativity but onlytested one parameter, i.e., illuminance or color temperature,and few studies have investigated the interactive/combined effects of ILL and CCT or considered the possible modulationeffects of mood states.

In this study, we aimed to address this knowledge gap by investigating the interactive/combined effects of ILL and CCT on creativity, hypothesizing that moods induced by lighting will probably inturn influence creative performance. Multidisciplinary knowledge including buildingphysics, psychology, and physiology were used in the study. Melatonin, a hormone produced by the pineal gland andis significantly affected by lighting and correlates with depression (Wetterberg et al. 1979; Ito et al.2013), was measured. Both figural and verbal creativity tasksthat measure different creative processes and analytical tasks that measure memory or calculation skills were used to investigate the effects of lighting on these two typesof tasks. This study identifies the combined effect of CCT and ILL on creativity-related skills and distinguish the performance change of analytical work and creative work by exploring physiological and psychological evidence.
This comparative study of illuminance and melatonin formation is inversely proportionate to the concentration of melatonin correlated with positive and negative affect.



The illuminance and correlated color temperature lightingconditions affect analytical tasks differently than creative tasks. The subjects performed analytical tasks better at cool color and a standard illuminance level (300 lx, 6000 K), in which they did not have high affective intensity in both negative and positive affect (Figures 6, 7). This result is consistent with Blanchette's (2006) findings that reasoning performance is related to emotional capacity and increases with neutral states. This suggests that not only affective intensity promote creative thinking, but it also has a detrimental effect on analytical thinking and memory; therefore, a neutralmood is more advantageous. The normally lit environment stipulated in the present standard is conducive to workproductivity.

Table 7 Spearman correlation (*R* square) between mood and lightperception

	Positive affect	Negative affect
Dark/Bright	0.21*	0.13
Depressing/Exciting	0.44**	−0.09
Dazzling/Soft	0.20*	−0.12
Limited/Spacious	0.05	−0.18

** Correlation is significant at the 0.01 level (2-tailed).

* Correlation is significant at the 0.05 level (2-tailed).

The present study observed higher positive mood at thestandard illuminance level and low CCT light (300 lx, 3000 K)(Figure 7), which are consistent with some previous studiesthat found warm light enhances positive mood (Baron et al.1992; Hsieh 2015). Cool light also increased the positive effect but only when correlated with a high illuminance level(2000 lx, 6000 K) (Figure 7), similar to the results observedby Zhu et al. (2019), possibly because the bright and blue-enriched light motivated an energetic mood that is advantageous for positive affect and mental activity (Deguchiand Sato 1992); this was partly confirmed in the present study that the participants perceived the bright cool light environment to be brighter and more exciting (Figure 9). As a prior study had shown, two stages are involved with mood changes, phasic and tonic arousal (Kuller 1991). Thefirst consists of the initial reaction to the environmental setting, while the second is related to a long-term habitationwith that setting. This leads to determining the actual mood shifts generated as moods, which are different from emotions, need time to manifest and are more persistent. This factor could explain the contrasting results we discovered with Ru et al.'s study (2019), where no interaction between the combined light parameters and positive mood was found. Furthermore, prolonged exposure to light creates complex interactions between the affective state and the lighting parameters (McCloughan et al. 1999).The complexity of this relationship explains the contrasting results of some previous studies and the present study. The results of this study are in alignment with Hsieh's findings which state that low CCT increased positive mood, but this result is not consistent with Hsieh's concerning high CCT (Hsieh 2015). Previous researchers have identified high CCT light as a generator of stress and anxiety that also activates the autonomic nervous system (Noguchi and Sakaguchi 1999), which might make exposureto this condition critical. As Butler and Biner (1987) have highlighted, extreme variations in light can lead to "dramatic"behavioral change in humans. This change consists of extreme variation of the affective state, which can lead to a changed cognitive responses. The responses are subject tothe affective state and how the lighting environment isperceived, in addition to the biological reactions. Although small correlations between the concentration of melatonin and positive mood and negative mood were observed (Figure 8), no difference in the concentration of melatonin was observed under the four lighting environments. Boycesand Kennaway (1987) reported that all elevated illuminancelevels of light, i.e., 1000 lx, 1500 lx, 2000 lx and 2500 lx, suppressed melatonin release significantly. Compared to 2500 lx, the 300 lx equally suppressed melatonin, accordingto one study (Bojkowski et al. 1987). These results suggest that only when the light is decreased to a very dim level does the release of melatonin increase.The correlation between mood and light perception (Table 7)and mood and melatonin, is to postulate that mood variations are related to physiological effects and also visual preferences.

CONCLUSION

The proportion of intelligence, analytical thinking, and critical assessment capability evidently, can have risen in illuminated surroundings.

This gesture and practice of following the illumination and remaining focused on the light point enlighten the mind and thinking of an individual. It paves the path to an innovative mindset towards success, with enhanced confidence and elevated intuitiveness of cognition. There is a positive difference in developing personality, improving confidence, and success with the help of illumination therapy. We further expect to perform experiments in this regard and bring more therapeutic accentuation to personality through these applications.

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