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DARK ARTS

CHAPMANBDSP REVEALS YIN-YANG DESIGN AT ME HOTEL

LIGHTING CONTROL NETWORKS - HOW EASY ARE THEY TO HACK?

DENISE FONG INTERVIEWED • HOTEL & HOSPITALITY LIGHTING

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THE AGE OLD QUESTION

Research about the impact of age on the perception of light quality by Dr. Karolina M. Zielinska - Dabkowska and Veronika Labancová of the University of Applied Sciences, Technology, Business and Design Wismar/ Germany, has given unexpected results.

It is commonly known that good lighting can have an enormous impact on people's health and well-being, moods, energy levels or even emotions, naming only a few aspects[1]. On the other hand, wrong illumination can produce visual discomfort, reduce the visibility and even create negative health problems[2]. Light can also influence the recognition of objects and the way we perceive them, it has impact on its colour, shape and texture[3].
Before beginning the research, the authors performed extensive examination on available literature related to the subject. In spite of the fact that a lot has been researched and written in recent years on issues related to colour and vision, there are few publications relating to LED light sources. One of the reasons possibly being that the technology of LEDs is recently new; there are still not commonly approved, standardised measuring methods and tools to compare aspects as colour rendering index and perception of light quality, in particular appearance of colour. Therefore the decision on conducting research in this field seemed to be very interesting and timely.
Following analysis, five theses have been defined which were going to be evaluated during the research process:

- 'An age of an observer can have an impact on visual perception of a colour of an object';
- 'An average observer is not able to distinguish the difference between higher luminance and lower colour rendering of a light source or vice versa. However, when getting older, an average observer naturally prefers higher luminance to better colour rendering';
- 'The eye disturbances due to medical conditions impact human vision and therefore perception of colour';
- 'The human vision and perception of colours may be influenced by the colour of the iris';
- 'Artificial lighting and working on computers plays significant role in vision aging and starting macular degeneration process'.

In order to review the correctness or falseness of the above theses, it was necessary to widen the research knowledge in aspects such as: medicine, lighting technology, knowledge about colours, colorimetry and vision, as the human perception of colour is influenced by these different aspects and interdisciplinary dispositions.
The Master Thesis combines not only theoretical (literature research) but also a practical approach in the form of a lighting experiment during the 30 minutes sessions that took place on 18th April 2013 at the Lighting Design Laboratory at Hochschule Wismar University of Technology, Business and Design in Germany. The lighting test consisted of two parts: the practical experiment and a questionnaire performed during the 20-30 minutes sessions. During the test, 55 respondents including members of the public as well as students, professors, lectures, administrative staff and other employees of university and some lighting professionals had to evaluate and compare the effect of three different scene settings on visual perception of diverse types of objects answering the questionnaire [Fig.1]. These were generated by three downlights with commercially available Xicato LED modules. The scene settings varied in Colour Rendering Index (80/95) and Luminance (1000lm/ 2000lm). Correlated Colour Temperature of 3000K was maintained for all three scenes.
As daylight is constantly changing and might have an impact on the final results of the test, the whole room was completely blacked out to evaluate only artificial lighting conditions.
CIE Standard Illuminant D65 (Daylight Illuminant) was used as a reference to compare the qualities of different light sources. There was no other additional artificial light source used, except a small task light above a table to help with reading the questionnaire. The layout set up in the room was so that these elements were not interfering with each other. The luminaires above the display stands were mounted at the height of 3m [Fig.2]. It was crucial that the scene's visual composition would be as compact as possible and easily comparable while viewing.
The topic of the research deals with the aspect of ageing and perception. Therefore, it was obvious that several age group arrangements were required. The authors defined five age groups based on an understanding of human vision anatomy and physiology as follows: Group 1 (18-29), Group 2 (30-39), Group 3 (40-49), Group 4 (50-59). The first age group began at 18 because eye development is finalised at that age when the eyeballs are no longer growing and all of the visual processes are stabilised.
Also when several light sources are being compared, it is good to have some objects that can be compared with each other. It is easier to describe some modifications between those sources since it would be very difficult for the human brain to evaluate only one standing colour sample and remember the results. Therefore, to evaluate the colour appearance three identical compositions of objects were placed on top of display podiums. There were three larger cubes, painted in the saturated colours of red, yellow and blue, which were made out of semi glossy plastic material. Some additional smaller cubes were painted in pastel colours (light green, blue, violet, brown and beige) having matt surfaces, as there are some hypotheses that discrimination between blue and green lessens with time as the eye ages[4]. Red colour samples had a special importance in the compositions, since this colour is one of the most difficult to be rendered by most artificial light sources.
Choosing appropriate light sources was very important aspect of the whole experiment, since the right setting up of lighting scenes can lead to a final success or failure of obtained results of research. The technical solution of the test was supported by LED manufacturer Xicato, who provided free samples of requested luminaires with specific LED parameters [Fig. 3]. This company is a worldwide leader in producing high quality LED modules with excellent CRI; some being Ra – 95 which can correctly render red colour (TCS 9). During the test where three scenes [Fig.4] are next to each other, an observer can perceive those tiny variations and can decide which scene settings seems to be the best according to rendered colour quality. The differentiation of those two factors were going to bring some answers to questions about if human beings prefer Luminance to Colour Rendering Index as main parameter of light quality and whether they can distinguish better CRI to higher Luminance or if they cannot perceive any difference at all. It was commonly believed before conducting the research that when those aspects are researched and answered, it would be possible to find appropriate ratio between Luminance and CRI based on age to deliver appropriate lighting solutions.

SUMMARY AND CONCLUSIONS

The evolution of collected data records gave interesting, unexpected results. It seems that our vision acuity comes to a head between age 30 – 40 years old. Participants of this age can perceive colour and luminance as the most balanced. Before conducting the research, the authors believed that the youngest group of participants between 18 – 29 years old could distinguish the quality of colours under different light setting the best. However, analysed data indicated that vision of this youngest group is not fully developed and still need some time to mature.
It can also be proved that when getting older, an average observer naturally prefers higher luminance to better colour rendering. With time, our perception changes and the decision about lighting quality is made according to luminance, rather than CRI.
Based on the lighting test, there is also an indication that eye surgery might influence capability of the visual system. By some respondents not wearing eyeglasses, due to their earlier eye surgery, the results were worse in comparison to average participants of each group. Therefore, it seems that there is an impact of eye surgery on the perception of light quality. Influence of perception of light quality by respondents wearing prescription eyeglasses was not observed. In the research the connection between the colour of the iris and its impact on perception of colours couldn't be proven due to the fact, that the amount of tested participants was not sufficient to dedicate any result.
Analysed data coming from participants above 40 years old shows that they spend less time in front of a computer compared to the younger generation. Among younger people there was no significant difference in perception of colour appearance between those who work less with computers and those who work more. Therefore, it is very hard to bring any valuable conclusion to this matter. However, younger respondents might have eyesight difficulties later in age, but earlier than their parents, due to the enormous time spent in front of computers and TV screens and the over-exposure to the blue end of the light spectrum which may also contribute to retinal damage and possibly lead to Macular degeneration[5].
The above results of the Master Thesis highlight the importance of specifying appropriate values of colour rendering and levels of luminance based on the user's age. The authors believe that, based on the conducted practical lighting research and by applying the findings in terms of the correct type of light source with the proper CRI and luminance related to the age of the observer, lighting designers can receive a tool to create a proper set of lighting guidelines for different environments. They can support physiological and psychological needs of people, creating welcoming, comfortable human friendly and enjoyable environments in spaces such as: retail, office environment, educational establishments, public and residential buildings or retirement homes.

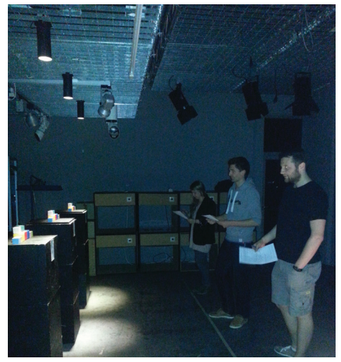

Fig.1. Participants during lighting test.

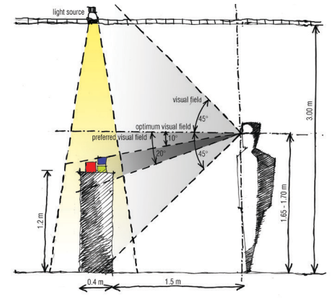

Fig. 2. Lighting test set up scheme, author's sketch.

Fig. 3. The Xicato LED Module.

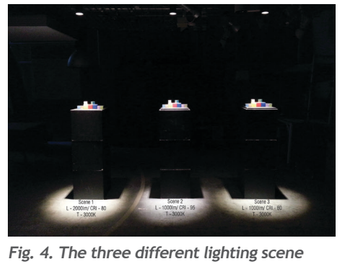

Fig. 4. The three different lighting scene settings during the test.

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