Atmosphere creation: the relation between atmosphere and light characteristics

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Abstract

The latest developments in lighting technology in the area of color and dynamics make it possible to create more appealing atmospheres. Hence, the focus of lighting research is changing from visual effects towards psychological effects, from white light towards colored light, and from static to dynamic designs. The goal of this study was twofold: First, we want to investigate what light characteristics lighting designers use to create certain atmospheres in the living room and second, what is the relation between these light characteristics and the atmosphere.

The results show that typically used parameters such as brightness and color temperature in combination with parameters such as color, beam shaping, and dynamics provide the best opportunities for creating appealing atmospheres in the living room. The relation between all these light parameters and the atmospheres *cosy*, *activating*, *relaxing*, and *exciting* are described in detail in this paper.

Conference theme: Methodological issues

Keywords: atmosphere creation, light characteristics

Introduction

Light can influence people’s mood, well-being and behaviour (e.g. Flynn, 1992; Knez, 1995; McColl and Veitch, 2001). In the past, research on interior lighting has mainly focused on the functional aspects, like visibility and visual comfort, which has resulted in guidelines for functional lighting. More recently, lighting designers and researchers have realized that a certain lighting cannot only be used for functional lighting but it also creates a certain atmosphere and affects people’s feelings. The latest developments in lighting technology in the area of color and dynamics make it possible to create a large variety of atmospheres. Hence, the focus of lighting research is changing from visual effects towards psychological effects, from white light towards colored light, and from static to dynamic designs.

In the past, the psychological effect of white light on mood has been studied extensively (e.g Knez, 1995; McCloughan et al., 1999, Knez, 2001) in contrast to the psychological effect of colored light. The psychological effects of white light on mood often revealed contradictory results. Most studies that exist on color have used colored patches in stead of colored light, which does not necessarily have the same effect on people’s mood. People’s mood is not only affected by lighting but also by many non-environmental factors, such as internal state and personal preferences. Hence, it is very unlikely that a lighting design in an environment will always affect a person’s mood to the same extent. In contrast to mood, the perceived atmosphere of on environment is expected to be a more stable concept. Atmosphere differs from mood in a sense that it is not an affective state but the affective evaluation of the environment. Although people might have different opinions about the atmosphere of an environment, it is expected that the effect of light on the perceived atmosphere will be more consistent than the effect of light on mood. Hardly any study has been conducted on the effects of lighting on the perceived atmosphere (Vogels, 2008).

In this paper an experiment is described that is part of a long-term study on the relation between perceived atmosphere and physical light characteristics (e.g. brightness, color temperature, color, beam characteristics, dynamics). In a previous study (Vogels, 2008), the effect of systematically changing light characteristics on the perceived atmosphere was investigated. In this study, the starting point was a certain atmosphere for which the light characteristics were determined. Professional lighting designers were used because they have this knowledge. The goal of this study was twofold: First, we want to investigate what light characteristics lighting designers use to create certain atmospheres in the living room and second, what is the relation between a certain atmosphere and light characteristics.

Experimental

Method

The design of the experiment was based on a questionnaire which was developed together with professional lighting designers and information from the book Talk Atmosphere (2004). Using the questionnaire, professional lighting designers were asked to create a lighting design for a standard living room for the atmospheres *cosy, activating, relaxing, and exciting*. The choice for these four atmospheres is based on a previous study (Vogels, 2007) which demonstrated that atmosphere can be described by at least two factors: cosiness and liveliness. For our experiment, we chose four atmospheres which are significantly different from each other according to the atmosphere metric in Vogels (2007).

In the questionnaire we made a distinction between (1) white general light, (2) white accent light, and (3) colored accent light. The questions for white general light were related to color temperature, average brightness on the horizontal planes, average brightness on the vertical planes, and the dynamics of brightness and color temperature. The questions for white accent light were related to brightness, color temperature, beam angle, beam characteristics, and the dynamics of these characteristics.

For the colored accent lighting, lighting designers had to indicate which color(s) they preferred in a certain atmosphere. For each color they had to answer questions related to brightness, saturation, beam angle, beam characteristics, and the dynamics of these characteristics.

Eight male and seven female lighting designers participated in the experiment. Their age ranged between 27 and 58 years. All designers worked for projects in Europe and had different backgrounds (e.g. interior lighting, retail lighting, outdoor lighting, and office lighting). Some designers qualified themselves as creative designers while others qualified themselves as technical designers. First, each designer was given a brief instruction about the experiment explaining the questionnaire and the four different atmospheres. Then the lighting designs of the four atmospheres were created in random order. The light designers were asked to focus on the perceived light effects.

Results

The data of the fifteen lighting designers was pooled because we found no effect of gender, age, or background. Figure 1 shows the average results of the color temperature of the white general lighting and the white accent lighting. The x-axis shows the four atmospheres and the y-axis shows the average color temperature. The error-bars correspond to the 95% confidence intervals.

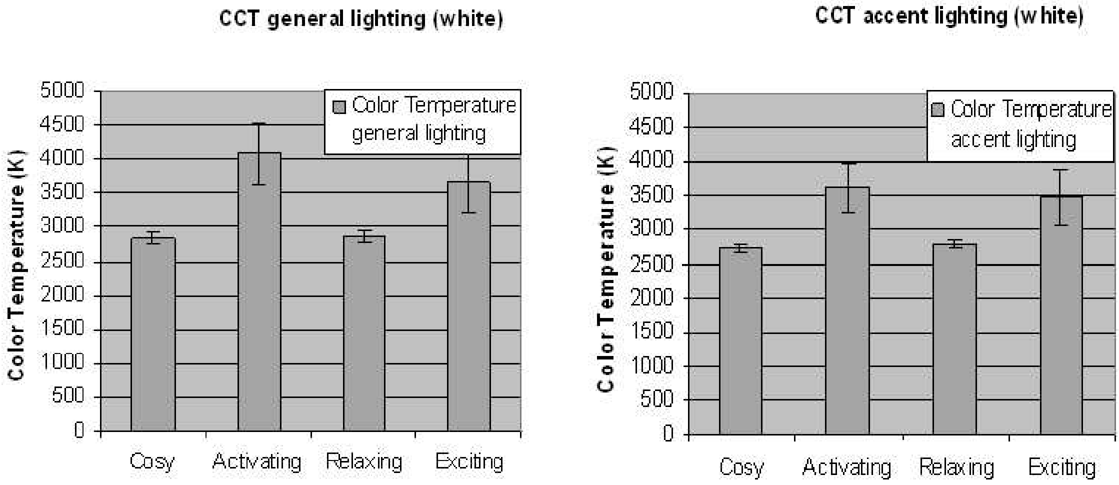

Figure 1: The average color temperature for white general lighting and white accent lighting. The error bars represent the 95% confidence intervals.

The data in Figure 1 shows that for all atmospheres the color temperature for white general lighting is similar to the color temperature for white accent lighting. In addition, color temperatures of the white general lighting and the white accent lighting are significantly lower for the atmospheres *cosy* and *relaxing* (+/- 2700 K) compared to *activating* and *exciting* (+/- 3800 K).

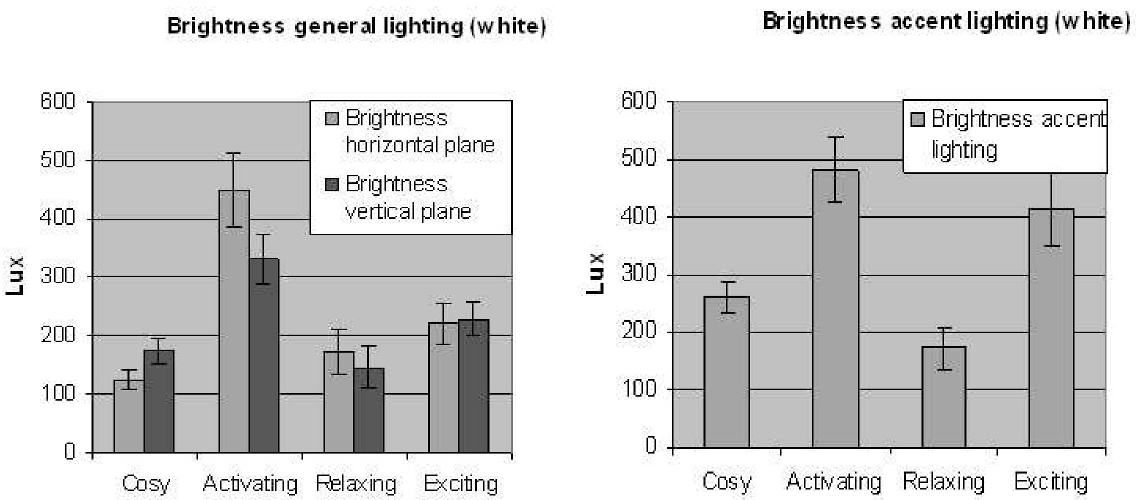

Figure 2: The average brightness for white general lighting and white accent lighting. The error bars represent the 95% confidence intervals.

In the left panel of Figure 2, the brightness results for white general lighting are divided into the average brightness on the horizontal plane and on the vertical plane. The brightness of the atmosphere *activating* is significantly higher than the other atmospheres. For the atmospheres *cosy*, *relaxing*, and *exciting* the brightness for the horizontal plane is more or less the same as that for the vertical plane. For the *activating* atmosphere more brightness is needed on the horizontal plane than on the vertical plane. In the right panel of Figure 2, the brightness results for white accent lighting are shown. The data shows that the brightness of the accent light is significantly higher for the atmospheres *activating* and *exciting* compared to *cosy* and *relaxing*. The *exciting* atmosphere shows a high contrast because the brightness of the general lighting is relatively low (left panel) compared to the brightness of the accent lighting (right panel).

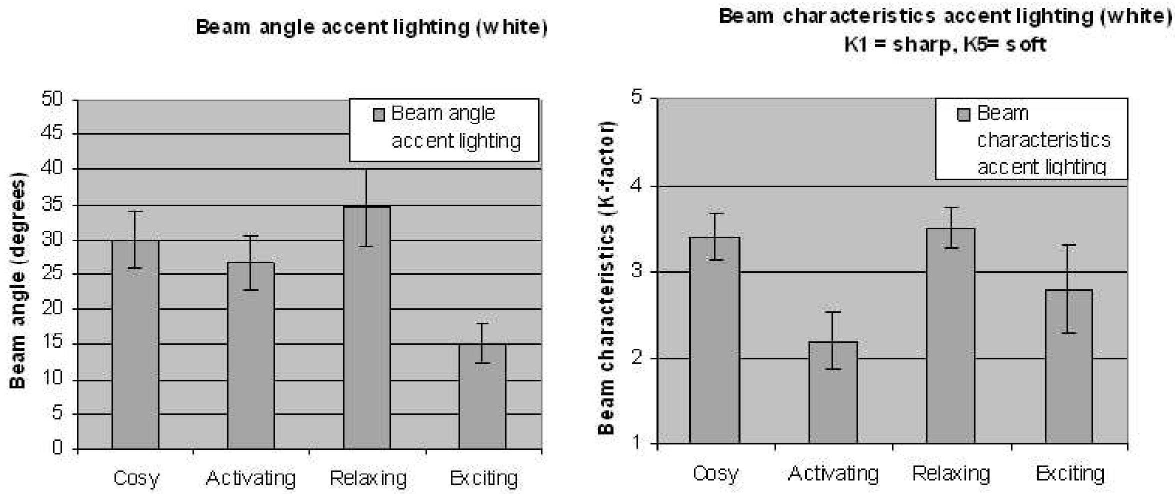

Figure 3: The average beam angle and K-factor for white accent lighting. The error bars represent the 95% confidence intervals.

The results for the beam shaping of the accent lighting are shown in Figure 3. The left panel depicts the beam angle of the accent lighting and the right panel depicts the K-factor of the beam (K1 = sharp edge, K5 = soft edge). For the atmospheres *cosy*, *activating*, and *relaxing* the beam angle is around 30 degrees and for the *exciting* atmosphere the beam angle is around 15 degrees. The K-factor for the *activating* and *exciting* atmospheres is lower compared to the K-factor of *cosy* and *relaxing*. In other words, accent lights with a softer edge should be used in *cosy* and *relaxing* atmospheres whereas accent lights with sharper edges should be used in *exciting* and *activating* atmospheres.

Regarding the dynamics in general lighting and accent quite some differences were found between the four atmospheres. For a *cosy* atmosphere almost all lighting designers prefer static light characteristics. In the *activating* atmosphere most lighting designers prefer slow dynamics (minutes, hours) in the general lighting (brightness and color temperature), whereas the light characteristics of the accent lights are mainly static. Only for the brightness of the accent lights, some lighting designers prefer slow (minutes, hours) dynamics. The *relaxing* atmosphere is mainly static. The only dynamics in a *relaxing* atmosphere is a slow (minutes) change in brightness of the accent lighting. Finally, in the *exciting* atmosphere most lighting designers prefer no dynamics in the general lighting in contrast to the accent lighting, which is fairly dynamic. The relative fast dynamics (seconds, minutes) in the accent lighting are mainly in brightness, beam angle, and beam characteristics (sharpness).

The results for the colored accent lights are shown in Table 1. Table 1 shows the main colors for each atmosphere and some characteristics of the accent lights.

Table 1: Light characteristics for the colored accent lighting.

Atmospheres	Colors	Saturation level	Beam angles (degrees)	Dynamics
Cosy	orange, blue	medium	50	static
Activating	blue, cyan	medium	50	static
Relaxing	green, blue	medium	50	static
Exciting	all colors	high	10,60	random (sec)

The results in Table 1 show that the atmospheres *cosy, activating*, and *relaxing* can be realized by using color pairs. For the *exciting* atmosphere the lighting designers prefer random changes of the color in the living room. The saturation level of the colored accent lighting is medium for the atmospheres *cosy*, *activating*, and *relaxing* and high for *exciting*. The beam angle for the colored accent lights are different from those of the white accent lights (see left panel in Figure 3). The beam angle for the atmospheres *cosy*, *activating*, and *relaxing* is around 50 degrees, which is larger compared to the white accent lights. In the case of an *exciting* atmosphere, lighting designers want both small accents (10 degrees) and large accents (60 degrees) in one design. Only in the *exciting* atmosphere the colors should change dynamically. The brightness and the beam characteristics (K-factor) are not shown in Table 1 because the results are similar to the results for the white accent lighting (see right panels Figure 2 and 3).

Conclusions

In this experiment, the relation between atmosphere and light characteristics was investigated using professional lighting designers. The goal of the experiment was twofold: First, we investigated what light characteristics lighting designers use to create certain atmospheres in the living room and second, what is the relation between these light characteristics and the atmosphere.

The outcome of the questionnaire showed that lighting designers were able to discriminate between the four atmospheres in terms of different light characteristics. Regarding the first goal of our experiment, the results show that lighting designers want to use more lighting parameters in the living room than typically used (brightness and color temperature). Although brightness and color temperature are very important, the experiment revealed that adding color, beam shaping, and dynamics to an atmosphere are crucial for creating different appealing atmospheres.

The outcome of the experiment regarding the relation between light characteristics and atmosphere will lead to new opportunities in the field of atmosphere creation in the home. A possible application is the definition of preset atmospheres which enable easy atmosphere creation in the living room. The results for the color temperature of general and accent lighting (white) shows us that *cosy* and *relaxing* atmospheres need a warmer color temperature than *activating* and *exciting* atmospheres. The atmospheres *cosy* and *relaxing* need a relatively low brightness compared to the atmospheres *activating* and *exciting* in the general lighting as well as in the accent lighting. The beam angles in the atmospheres *cosy*, *activating*, and *relaxing* are more or less equal (around 30 degrees) whereas the beam angle in the *exciting* atmosphere is smaller (around 15 degrees). The beam is softer in a *cosy* and *relaxing* atmosphere and a little bit sharper in the *exciting* and *activating* atmosphere. The *cosy* atmosphere is completely static for all light parameters. In the *activating* atmosphere, lighting designers want small variations in color temperature and brightness of the general white lighting. The *relaxing* atmosphere is mainly static with small changes in brightness of the white accent lighting. An *exciting* atmosphere in the living room should contain a lot of dynamics. Especially, dynamic color transitions, dynamic beams, and brightness variations.

This experiment gave valuable insight in the relation between atmosphere and different lighting characteristics. A next step is to evaluate the four atmosphere designs with end-users. Furthermore, it would be interesting to investigate the effects of other modalities (fragrance, touch, audio) in combination with lighting on the perceived atmosphere.

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