USER RESPONSES TO LIGHTING DESIGN

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1. INTRODUCTION

The study described in this paper attempt to investigate if the lighting designer can use his or her own preferences for levels of light for the task lighting and the ambient light in the design and still come close to the subjects needs. It is also to investigate if reasons can be seen that explains a positive or negative response among the subject´s on the design of the light. Lighting design is an important part of everyday's life and need to be designed close to the user's needs. With a visual comfort test and self assessed instrument is data collected about the user's experiences when staying in the three alternative room and light settings in the study. The article shows that the visual comfort test (VCT) reveal a span of preferences for light levels in the group of subjects that can be compared to the lighting designer and be useful for lighting design.

2. BACKGROUND

The way light is designed is an important part of everyday's life. The discovery of the intrinsic photosensitive Retinal Ganglion Cells (ipRGC) increases the complexity in the topic lighting science [Berson 2001; 2007] and in lighting design. Light for the indoor environment need to be designed to suit the user's neurophysiologic disposition as the foundation for an individual ergonomic approach to lighting design [Ingvar 1981]. The subject´s experiences of, responses to, preferences for and behaviour in room and light settings is by daylight put into a diurnal rhythm. When Lighting Science is developed closer to physiology the complexity of the topic will increase further. Dr. Marijke Gordinj describes the role of light in our lives with the following quotation. Light have an impact "to almost all human physiological processes and behaviours" Dr. Marijke Gordinj.

The simultaneous input of electromagnetic radiation (EMR) to the visual sight and ipRGC makes visual comfort to a key question when designing the more physiological and visual supportive light. The use of the visual comfort test in the study is a way to in a neutral matter compare the lighting designer's preferences in the reading situation and for the supporting complementary ambient light in a given contrast situation with the group of subject´s and between the subject´s.

3. PROBLEMFORMULATION AND AIMS

3.1 Problem formulation

The lighting designer uses his or her own senses in the work of lighting design. Here the own preferences for light is an important part of the design. But can the lighting designer use his or her own preferences

when doing lighting design for unknown end-users?
Will the subjects appreciate or reject the lighting designer's preferences and can a reason be found to this? Can the VCT be used as a neutral reference with the purpose to in advance see if the preferences of the designer and end-users are close?

3.2 Aims

To find out if: it is possible for the lighting designer to use his or her own preferences for levels of light at the working table and for the ambient light when doing lighting design for 20 unknown users.
To investigate if: the subjects in the study come close to or far away from their needs for a visual comfortable level of light at the working table and in the ambient light when staying in the light planned by the lighting designer.
To evaluate if: it is possible to use a visual comfort test (VCT) in order to compare the lighting designers and the subject´s general preferences for light in a comparable way.

3.3 Research questions

Is it possible for the lighting designer to use his or her own preferences for levels of light at the working table and for the ambient light when doing lighting design for 20 unknown users?
Will the subjects in the study come close to or far away from their needs for a visual comfortable level of light at the working table and in the ambient light when staying in the light planned by the lighting designer?
Is it possible to use a visual comfort test (VCT) in order to compare the lighting designers and the subject´s general preferences for light in a comparable way?

4. METHOD

4.1 Study design

In order to find more information about user preferences to the design of artificial light for the indoor environment, data was collected about 36 subject's experiences of three room and light settings. A second part of the study was the visual comfort study (VCT) where the lighting designer and 18 of the 36 subjects participated. They evaluated their visual preferences according to preferred level of light at the working table and for the complementary ambient light. The lighting designers measured preferences for level of light was then compared with the group of 18 students who were enrolled in the Lighting Design Program at Jonkoping University. The main study was conducted at the School of Engineering at Jonkoping University in December 2005. Thirty-six (36) university students completed all segments of the main study. Test subjects for the study were recruited via e-mail messages which were sent to all students at the School of Engineering at Jonkoping University. Forty (40) of these were invited to participate. The remaining three were excluded because there was no space to accommodate them in the group. Thirty-six (36) people completed all sections of the study. Four (4) participants were excluded due to incomplete data. The 36 test subjects consisted of 11 men and 25 women (m=25.9 years). Among the group, 16 women and 6 men were students at the Department of Lighting Science at the School of Engineering at Jonkoping University. The others were enrolled in different departments at the School of Engineering. Each participant was allowed to order a book as compensation for their participation.

4.1.1 Instruments used in the study

PANAS: Emotional state was measured with 10, five-grade semantic scales (PANAS scales), [Watson et

al. 1988].
The perception of lighting quality: The ambient light was measured through a questionnaire, on which test subjects were asked to on a paper circle the three words that best described their experience of the lighting in the room. In the test 34 words as a total was used, 21 positive and 13 negative and was listed on one sheet of paper. Chosen as positive was the words shaded, comfortable, good, diffuse, subdued, absence of flicker, focused, even, and cold, clear, concentrated, bright, shiny, mild, soft, natural, uncolored, uneven, abroach, varied, and warm. Chosen as negative was glary, bad, uniform, flickering, colored, hard, sullenly, dark, uncomfortably, unpleasant, unnatural, sharp, strong, weak. The word good, pleasant and comfortable was counted and given one point each. In the same way and by using the same instrument was the light at the reading area and workspace evaluated.
Positive room descriptive words: The subjects were asked when they left the study to describe the room they just left as carefully as possible. The positive room descriptive words were counted and were given 1 point each. No limit was set for the number of words that were counted. The test was developed by Monica Säter at the Department of Lighting Design at Jonkoping University in 2006. The instrument, positive room descriptive words, was used in Study number 1. The test was used and every free formulated positive room descriptive word was counted. No limit was set for the number of words counted.

4.1.2 Procedures in the study

The test subjects were welcomed and placed in one of the three rooms with a balanced order of presentation. Instructions to the test subjects were transmitted via MP3 players.
There was then a 15-second period of silence. They were asked to sit at the work table. This was followed by 10 seconds of silence. The test subjects were instructed to carry out Task 1, after which there was 5-minute period of silence. They were then instructed to proceed to Task 2, after which there were 2 minutes and 30 seconds of silence. The test subjects were asked to carry out Task 3. There was then a period of silence lasting 2 minutes and 30 seconds. The test subjects were asked to sit in the reading chair. This direction was followed by a 15-second period of silence. They were then asked to read newspapers for 3 minutes. The test subjects were asked to proceed to and carry out Task 5, which was to be followed by a 4-minute period of silence. They were subsequently instructed to proceed to Task 6. This was also followed by a 4-minute period of silence. The test subjects were instructed to carry out Task 7. This was followed by another 4-minute period of silence, after which they were instructed to leave the room.
Once outside, they were instructed to carry out Task 8. Following this, the test subjects were assigned new room numbers and instructed to go to these rooms. These procedures were repeated a total of three times. The test subjects spent equal lengths of time and carried out identical tasks in each of the three rooms (table 1).

4.1.3 Statistics used in the study

Data was analysed with the use of mean and frequencies.

4.2 THE VCT

VCT: The test was developed by Dr. Bo Persson at KTH in Sweden. It was used to measure the preferred level of light at the working table. Bo Persson did the test with a white paper on a white table and repeated the procedure for three times. Then he did the same procedure with a white paper on a black table. The test was completed in 2006 by M. Säter to be used for measurement of both the level of light at the working table and for the preferred complementary level of ambient light. A white paper on a black table was used in Studies 1, 2, 3, 4, and 5 in the thesis.

Study number four focuses on the preferences for a visually comfortable level of light at the working table and for the ambient light. The study was performed in one of the rooms used in Study number 1 and in one room used in Study number 3. The VCT test measures the subjects´ preferences in a given contrast situation. A white paper is placed on a black table. The test starts in the room which is dark and the level of light is taken up to maximum, down again, until the subject recognises their individual level of light experienced as visually comfortable. The preferred level of light is measured as horizontal (the table) and vertical (ambient light) illumination with a light meter. Then, the level of light for the working table is kept and the ambient light is added. The level of ambient light is taken up to maximum and then down until the most visually comfortable combination of level of light at the working table and for the ambient light is found by the individual subject. The procedure is done three times and the third measurement is counted. The VCT test was used in the same way in Studies 1, 2, 3, 4 and 5.

4.2.1. VCT

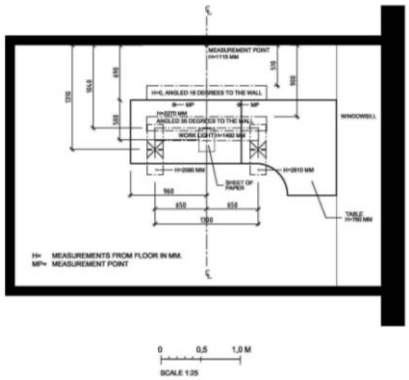


Figure 1. Floor plan, Visual comfort test.
Pendant luminaire Lamp 1, Pendant luminaire Lamp 2, Pendant luminaire Lamp 3, Control dimmers on table, 1-10V converter Digi DIM 470. Lighting control, ATCO PCA 2/54 15XL one size LP
Lighting control: qt-t/e1x26/230-240 dim. Lighting control: PCA/49. Light source 80-3950 Lux. Work lamp gives 0-(80)-3950 Lux. Ambient light gives 0-(10)-550 Lux. Total 0(90)-4.500 Lux

4.2.2 Contrast situation in the VCT

White paper, NCS 9000, reflection factor 1.9. White wall, NCS 0500, reflection factor 87%.

4.2.3 Procedures in the VCT

00-00.20: Test subjects were welcomed by the research leader and shown into the room.
00.20-2.10: Test subjects sat at a table with a white piece of paper upon and received instructions

on the various stages of the experiment via a tape recording and a loudspeaker. The test subjects began with the control for Dimmer 1 in position 0. They then increased the brightness to the maximum level, before reducing it to a level that they deemed would allow them to comfortably read black letters on a white background that had been affixed to a black fabric. The strength of the horizontal illuminance was measured with a calibrated luxmeter and was recorded by the test leader. The selected level was maintained and the test subject was instructed to increase the brightness of the light in the room by first sliding the control for Dimmer 2 to its maximum setting before moving it to the level with which the test subject felt comfortable. 2:18-3:49: The test subjects started with the control for Dimmer 1in position 0 and increased the lighting level to the maximum strength; they then slowly reduced the strength to the level they felt would allow them to in a comfortable way read black letters on a white background that had been affixed to a black fabric. The strength of the horizontal illuminance was measured with a calibrated lightmeter and recorded by the test leader. The selected level was maintained and the test subject was instructed to increase the brightness of the light in the room by first sliding the control for Dimmer 2 to its maximum setting before moving it to the level with which the test subject felt comfortable. 3:57-4:47 the test subjects started with the control for Dimmer 1 in position 0 and increased the lighting level to the maximum strength; then they slowly reduced the strength to the level they felt would allow them to in a comfortable way read black letters on a white background that had been affixed to a black fabric. The horizontal illumination strength was measured with a calibrated lightmeter and recorded by the test leader. The selected level was maintained and the test subject was instructed to increase the brightness of the light in the room by first sliding the control for Dimmer 2 to its maximum setting before moving it to the level with which the test subject felt comfortable.
4:55- 5:37 the test subjects moved the control on Dimmer 2 to the maximum position. They then moved it back down until they achieved a level of ambient light with which they were comfortable. The reading was recorded in the table for ambient light. The experiment was then terminated.

4.2.4 Instruments used for measurements in the VCT

A calibrated luxmeter were used to measure vertical and horizontal illuminance.

4.2.5. Design of Room 1, 2 and 3

The design of the room and light settings was done in a descending level of visual comfort and can be seen in figure 2-13 and is described further in table 1-8.

Fig. 2. Study 1 R 1

Fig 3. Study 1 R 1

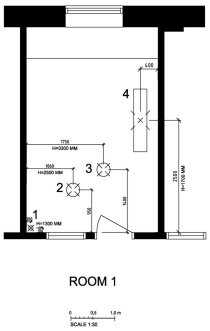


Fig. 4. Floor plan

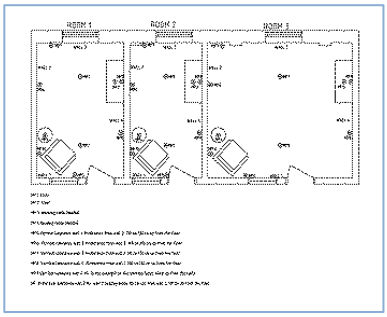


Fig.5. Floor plan

Table 1. Room 1 L1-L4.

Light sources/ Luminaries, Room 1

L1= Floor standing reading lamp, Halogen 4clear restr. dimmable.

L2= Downlight, Halogen 100W clear

L3= Down light, T/E 26W/830

L4= Pendant worktask lum. TL 5 49W/830 restricted dimmable

Table 2. Room 1 Horizontal illuminance

MP1	Floor 1	190 Lux	HI
MP2	Floor 2	95 Lux	HI
	W-table	75-950 Lux	HI
	R-table	410 Lux	HI

Fig. 6. Room 2. Work place

Fig. 7. Reading place.

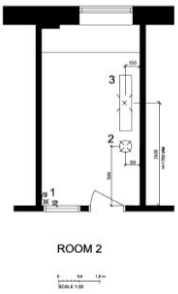


Fig. 8. Fl.plan Room 2

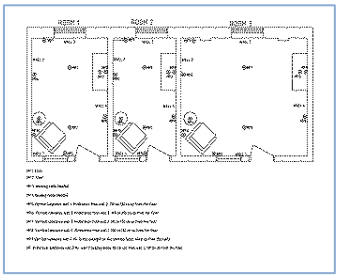


Fig. 9. Wall 1-4, m p Room 2

Table 3. Floor plan L1-L3**.**

Light sources/ Luminaires Room 2

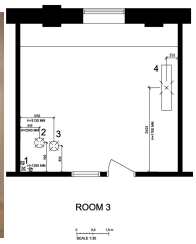
L1= Floor standing reading lamp Halogen 100W opal and Halogen 50W. Dimmable

L2= White tubular cloth lamp, 3xa60 60 W.

L3= Table standing work task luminaire. 36W/840 Dimmable

Table 4. Horizontal illuminance

Mp 1 Floor	175 Lux	HI
MP 2 Floor	103 Lux	HI
W-table	53-3100 Lux	HI
R-table	900 Lux	HI



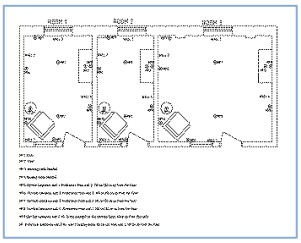


Fig.10. R3 **Fig.11.** R3 **Fig.12.** R3 **Fig.13.** R 3

Table 5. L1-4.

Light sources/ Luminaries, Room 3.

L1= Floor standing reading lamp, halogen 4 clear, restr. dimmable.

L2= Ceiling mounted down light, halogen 100W clear

L3= Ceiling mounted down light, PL-T 18W/830/4p

L4= Pendant work task luminaries. Svitch dim, fluorescent PL-T 28W/830. Filter CTB

MP 1	Floor 1	275 Lux	HI
MP 2	Floor 2	105 Lux	HI
	W-table	53-3100 Lux	HI
	R-table	900 Lux	HI

HI=Horisontal illumination

Table 7. Measurements points M1-8

Measurements point	**HI Lux,**		
	Room 1	Room 2	Room 3
Measure point 1. Floor	190 Lux (MP1Floor)	175 Lux	275 Lux
Measure point 2. Floor	95 Lux (Mp2 Floor)	103 Lux	105 Lux
Working table	75-950 Lux (Working table)	53-3100 Lux	41-520 Lux
Reading table	470 Lux	900 Lux	600 Lux

Room and light setting nr. 1-3.

The walls in Rooms 1, 2 and 3 were painted with white plastic paint, color code NCS 0500. The floors in Rooms 1, 2 and 3 were covered with linoleum with patterns in the following colors: NCS 2010-Y30R, 4040-Y30R and 3502-B. The ceilings in the three rooms were painted with plastic paint in color NCS 0500. All three rooms had workspaces consisting of a wooden table with black metal legs and

a chair. The chairs had wooden frames, with seats made of leather. In addition, there was a linen-covered armchair in the reading area of each room. The threads in the fabric were in the colors NCS 5010-Y30R and 0500. In Room 2, the armchair was covered with a cotton fabric in color NCS-3070-Y90R. Beside the reading chair was a round pinewood table with white tabletop. There was a white woven wool mat on the floors of Rooms 1, 2 and 3.
In Room 1, the window was decorated with a linen curtain in color NCS 4005-Y50R. In Room 2, the curtain was cotton and in color NCS 0500. The curtain in Room 3 was also linen and in color NCS 1010-Y20R. The Venetian blinds in Rooms 1 and 3 were covered with linen fabric in the color NCS 4005-Y50R. The blinds in Room 2 were not covered. The red band that held the wooden slats were of the color NCS 4050-Y70R. As a complementary feature to the décor, a piece of cloth was placed on the table beside the armchair. The cloth in Room 1 was made of cotton and was of the color NCS 1005-Y20R. The cloth in Room 2 was of the color NCS 4060-Y90R with traces of 0005-Y20R. The cloth in Room 3 was made of cotton and in color NCS 1005-Y20R.

5. Results

Room number 2 is the room where the subjects felt most interested and inspired in and described with the most positive descriptive words (Table *9 and 12).*

Room and light setting nr 2 is also the room that the test subjects perceived as having the highest quality of light at the reading area, at the workspace and had the highest quality in the ambient light (*Table 10 and 11).*

Table 9. PANAS, Interested, inspired scale=1-5+

Mean value	Room 1	Room 2	Room 3
Interested	3,2	3,4	3,1
Inspired	2,6	3,0	2,6

Table 10. Perception of lighting quality: ambient light

Mean value	Room 1	Room 2	Room 3
Lighting quality, Amb light*	0,2	0,6	0,1

34 words *good, pleasant, comfortable, 1 point each **(0-3+)**

Table 11. Mean for perceptions of lighting quality: light at reading area and in workspace (0-3+)

Mean value	Room 1	Room 2	Room 3
Lighting quality, reading area *	0,8	2,0	0,6
Reading area light, level of support for visual performance**	1,6	1,8	1,4

*34 words, good, pleasant, comfortable, 1 point each **

Table 12. Positive rooms descriptive words (PRW)

PRW			
Mean value	Room 1	Room 2	Room 3
PRW	0,9	3,4	0,6

Free formulated instrument. 1 positive word= 1 point. No limit.

18 of the 36 subjects participating in the study got their preferences for visual comfort measured in the VCT and the individual result was compared to the levels of light in the room and light settings in the study.

A huge difference between the lighting designer and the subject's preferences for light can be seen in the result of the VCT for the lighting designer and the result of the same test for the subject´s (Table *13, 14 and 15*).
In Room 2 was 14/18 subjects able to stay in their own preferences in level of light at the working table measured in the VCT and 1/18 subject was close (close=+-200Lux) to the preference in Room 2. 2/18 subjects were able to stay in their own preferences for the ambient light and 5/18 was close in Room 2 (*Table 15, 16 and 17*).
In Room 1 had 2/18 subjects the possibility to stay in their own preference in level of light at the working table and 2/18 subjects was close in Room 1. 2/18 subject had the possibility to stay in their preferences for level of ambient light and 6/18 subject was close to their preferences in Room 1.
In Room 3 had 1/18 subjects the possibility to stay in their own preference for level of light at the working table and 0/18 subjects were close to their preferences in Room 3.
1/18 subject had the possibility to stay in their own preference in level of light in the ambient light and 4/18 subject was close in Room 3.
Despite the 18/36 subjects that participated in the VCT was far from the lighting designers preferences for level of light in the three room and light settings (table 14, 16, 18), 14/18 subjects was able to find their own individual preferences at the working table in Room 2.

Table 13. Individual values for viewing illuminated surfaces with a high level of visual comfort and room designer's measured preferences for supplementary levels of ambient light in a given contrast situation.

	Test 1		**Test 2**		**Test 3**	
	Table A Horizontal illumination	Amb l. Vertical illumination	Table A Horizontal illumination	Amb. l Vertical illumination	Table A Horizontal illumination	Amb l. Vertical illumination
Monica Säter	443	82	355	92	368	119

Table 14. Individual values for viewing illuminated surfaces with a high level of visual comfort and the measured preferences of 18 test subjects (TS) for supplementary levels of ambient light in a given contrast situation.

	Test 1		**Test 2**		**Test 3**	
TS	Table A	Amb light.	Table A	Amb light	Table A	Amb light
1	4160	1480	4050	1530	4300	1300
2	3950	830	3700	1000	3000	1400
3	3000	980	3790	760	3700	530
4	1510	130	2400	290	1560	140
5	2740	930	1620	580	1280	570
6	1320	70	1310	90	1230	70
7	2060	590	1680	540	810	270
8	1940	470	1440	390	1380	320
9	3300	490	3070	300	1150	160
10	870	670	1280	390	1150	990
11	1840	650	1830	740	2060	320
12	3800	1730	4030	680	4130	1000
13	1500	350	2400	510	3100	550
14	2790	770	3200	1030	3320	1160
15	2650	500	3270	760	310	680
16	2360	220	3060	1810	2760	330
17	730	1480	2720	1200	2300	790
18	970	60	420	280	810	110
M	**2305**	**688,9**	**2515**	**715,55**	**2297,2**	**593,9**

Table 15. Measured levels of sensitivity in viewing illuminated surfaces and for supplementary levels of ambient light

	Test 1		**Test 2**		**Test 3**	
	Table A	Amb light	Table A	Amb light	Table A	Amb light
M. Säter	443	82	355	92	368	119
Mean*	2305	688,9	2515	715,55	2297,2	593,9

Mean* for 18/36 subjects participating in the VCT

Table 16. Preferences for level of light at the work table and for ambient light

Subj.	Workpl.	Amb	Room1 w.pl	Room1 amb l	Room 2 w.pl.	Room 2 amb l	Room 3 w.pl.	Room 3 amb l
			75-950	35(49)	53-3100	120	41-520	88(35)
1	3950	1300	-	-	-	-	-	-
2	3000	1400	-	.	Within	-	-	-
3	3700	530	-	-	-	-	close	-
4	1560	140	-	Close	Within	Close	-	close
5	1280	570	-	-	Within	-	-	-
6	1230	70	-	within	Within	within	-	within
7	810	270	within	Close	Within	Close	-	close
8	1380	320	.	Close	Within	Close	-	close
9	1150	160	close	Close	Within	Close	-	Close
10	1150	990	close	-	Within	-	-	-
11	2060	320	-	Close	Within	Close	-	-
12	3950	1000	-	-	-	-	-	-
13	3100	550	-	-	Within	-	-	-
14	3320	1160	-	-	-	-	-	-
15	3100	680	-	-	Within	-	-	-
16	2760	330	-	Close	Within	-	-	-
17	2300	790	-	-	Within	-	-	-
18	810	110	within	within	Within	within	-	close
Subj.			**2*/2****	**2*/6****	**14*/1****	**2*/5****	**1*/0****	**1*/4****

*Within=the preference, **close to preference= +-200 Lux

Table 17. Lighting designers preferences for level of light at the working table

Lux			Room1 w.pl	Room1 amb l	Room 2 w.pl.	Room 2 amb l	Room 3 w.pl.	Room 3 amb l
			75-950	35(49)	53-3100	120	41-520	88(35)
M. Säter	368	119	within	Close	Within	close	within	close
M subj 1-20	2305	688,9	2305	688,9	2515	715,5	2297,2	593,9

6. DISCUSSION OF RESULTS

The result of the study point out the importance of the task lighting and the low level of ambient light that make it possible to stay close to the individual preferences for level of light at the working table. The group of subjects is small and need to be increased in number to be able to give a general answer. The subjects were not able to evaluate the three light and room settings at the same time and this may have affected the results in a negative way. Although the VCT seems to works well as an instrument for evaluation of preferences for levels of light but the result is not useable as a role model for an ideal light levels for a certain person. The choice of the most comfortable level will always be dependent on the subject's condition and interaction with light, color and space in the surroundings. The preferences are here suggested not being static instead they are changing during the day [Ranchi 2009, Aster 2011]. When the lighting designer use his or her own preferences for light as a tool for the design of a visual comfortable interaction between MLCS, adjustments in the design is needed if the designer is positioned in the more extreme parts of the normal distributions curve of preferences for levels of light at the working table and for the ambient light in the indoor environment.

6.1 DISCUSSION OF METHODS

Methods used in the study were the VCT and semantic scales and self assessed instruments. It seems possible to use VCT as a neutral reference point in order to compare the lighting designer's preferences to the subject´s or the subject´s preferences to each other. Still the measured preference is not a fixed position, it is a rough estimation and will change during the day. The preference will change, here suggested, within a span related to the specific indoor contrast situation. If the subject´s is able to in a precise way evaluate their preferences for levels of light is another subject that needs to be discussed. It seems reasonable that the naïve subject´s will be less exact in their evaluation of preferred levels of light compared to the more trained subject´s. The quality of the data depends on the subject´s ability to show their preferences as exact as possible.

The study is restricted in number of subjects and the subjects are rather young and inexperienced. The lighting design students participating in the study is more precise in their visual judgments than ordinary students at the same University also participating in the study. It is a matter of being trained to evaluate visually the needs for light in a room and to put words on the experience. The quality of the data is dependent on being close to the subjects experiences of the room and light setting.

7. CONCLUSION

The study reveals that is was not possible for the lighting designer to use his or her own preferences for levels of light at the working table and for the ambient light when doing lighting design for 20 unknown users. Preferences for levels of light shows large interindividual differences in general [Paper I] and can be seen in the group of subjects in the study as well. The subjects was far from the lighting designers preferences o levels of light and by that far from their needs for a visual comfortable level of light at the working table and in the ambient light when staying in the light planned by the lighting designer. Despite this it was possible for 14/18 measured subjects to stay within the preferred level of light at the working table but not in the ambient light.

It was possible to use a visual comfort test (VCT) to compare the lighting designers and the subject´s general preferences for light in a comparable way. But the test situation are not the same as in the room but it is likely that the preferences for proportions, more light on the table and less in the ambient light that all subjects had is a general preference that can be seen in the study of 318 subjects [Paper I]. The lighting designer´s preferences for low levels of the ambient light suits the subject´s that prefer to stay in low levels of light and give in the same time the subject´s that need higher levels of light a possibility to compensate the level of ambient light through well adjusted task lighting. The low level of the ambient light and the well designed task lighting seems to be the key to the positive response for the room and light setting (Table 15, 16, 17).

7.1 FUTURE WORK

Moore needs to be known about preferences for light. Methods for lighting design that fulfill goals of lighting design need to be developed. If research is focused on the individual users needs the result can help out the hard work of the lighting designer.

Knowledge about how to handle interindividual differences in preference for light is needed. Research in this part of the topic is helpful for the lighting design process as well.

Will the subjects in the study come close to or far away from their needs for a visual comfortable level of light at the working table and in the ambient light when staying in the light planned by the lighting designer?

Research in span for preferences for light related to the diurnal rhythm and the indoor contrast situation is a useful tool for the lighting designer. Is it possible to use a visual comfort test (VCT) in order to compare the lighting designers and the subject´s general preferences for light in a comparable way?

Additionally research I needed in user’s responses to and preferences for room and light settings. Preferences for level of light need to be pictured as a normal distribution curve for visual sensitivity for the reading situation. Collected users experiences and normal distribution curves for visual sensitivity have the possibility to enhance a more ergonomic lighting design in the

future. More studies in the field of how to do lighting design close to the individual subject´s needs psychologically, physiologically and visually have the possibility to increase the quality of the interaction of man, light, colour and space.

8. ACKNOWLEDGMENTS

I wish to express my gratitude to Lena Gustavsson and family, for financial support through the Bertil and Britt Svensson´s foundation for Lighting Technique. I also acknowledge Mikael Petersson for technical support and work as research leader.

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