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EFFECT OF LIGHTING COLOR ON HUMAN PERFORMANCE

Ratri Atmoko Benedictus
Human Factor Engineering Dept., Hochschule Niederrhein, Germany
Faculty of Psychology, Atma Jaya Catholic University of Indonesia

Abstract

Workplace with poor in lighting directly influences the emergence of eyestrain among workers. In long term exposure, it may be resulted in occupational stress, increase the psychological burden and even lead to depression among workers. This study tested whether the particular color of lighting influence work performance. 25 participants were involved in this experimental study that had been performed at Human Factor Engineering Laboratory of Hochschule Niederrhein. Three color combinations of light were provided as independent variable, namely white-white, white-pink, and white-blue. Schätzskalen zum kurzfristigen Beanspruchungserleben (Scale for short-term stress estimation) from Hacker et al. was utilized to measure several aspects of work performance as dependent variable, particularly performance efficiency, achievement motivation, and concentration during work. Analysis of variance resulted that there is no difference in the performance between the lighting color groups on the second stage of the experiment. One Factorial Analysis further resulted in the difference on work performance within subjects which indicates the increasing performance of each experimental stage. And last, by Two Factorial Analysis, the result indicated that there are differences between the gender groups at each stage of the experiment in terms of concentration and working motivation. The mean difference between gender groups shows that female's groups have higher concentration levels. Whereas, the male's group is higher in terms of work motivation. Considering the contribution of lighting for human performance, It is necessary to consider the quality of light in the workplace, not only in terms of illumination level but also the color of light.

Keywords: Lighting, Color of light, Workplace, Human Performance

INTRODUCTION

Most people spend nearly 12 hours per day for working at indoor environments which can greatly influence their mental, working attitude and mainly their performance (Vischer, 2008). Due to most working activities are directly related to the sense of sight, lighting become the most important elements within working environment (Assaf & Aswalha, 2013). Research of Hameed and Amjad (2009) show that lighting condition in the bank offices in Pakistan has highly correlated to the productivity among its employees (r= 0.720 at 0.01), compared to another factors, namely furniture, noise, temperature, and spatial arrangements. Not just impact to productivity, Kakooei et al (2009) founded that bright light had changed in perception toward stress and burnout syndrome among nurses with working night permanent shift at Iran. Moreover, research of Woo & Postolache (2008) resulted that poor light at work represent an antecedent of depression among workers and can lead them to a suicide.

Poor in lighting, both in level of illumination or type of color, make the visual system work harder and may lead to symptoms which commonly described as eyestrain. Symptoms of eyestrain vary according to the lighting conditions and the task being carried out. AIRMID Health Group (*na*) presented several problems that affected by poor lighting in working

context. In individual level, inadequate lighting can lead to irritation, itchiness, breakdown of vision, blurred or double vision, and referred to several physical symptoms, such as headaches, fatigue, and giddiness. Whereas, in organizational level, poor lighting at work can resulted to a significant cost to business in the form of time off work as a result of accidents or injuries, increased absenteeism, and reduced productivity among employees. Due to the importance of lighting on human performance, the main question that might be answered through this research is do the type of color of lighting influence the human performance in the working context.

LITERATURE REVIEW

Since poor lighting potentially increase the risk of injury at work, the organization need to considered in designing its work environment. ILO (*n.a*), on its occupational safety and health brief, state that it is important to consider the level of illumination or the amount of luminous flux per working area (*see on the table 1*). Working with the big moving object need a lower level of illumination than to working that required fine detail.

Table 1: Lighting Intensities Required for Different Types of Work

Activity	Typical Location	Average Illumination (lux)	Minimum Illumination (lux)
Movement of people, machines and vehicles	Lorry park, corridors, circulation routes.	20	5
Movement of people, machines and vehicles in hazardous area; rough work not requiring any perception of detail.	Construction site clearance, excavation and soil work, loading bays, bottling and canning plants.	50	20
Work requiring limited perception of detail.	Kitchens, factories, assembling large components, potteries.	100	50
Work requiring perception of detail.	Offices, sheet metal work, book binding	200	100
Work requiring perception of fine detail.	Drawing offices, factories assembling electronic components, textile production.	500	200

Resource: OSH Brief No. 3C

In term of color of lighting, IAPA (2008) stated that since color of lighting can also help to improve the its contrast, several context of work need to differentiate its light color againts the background of working environment in the form of ceiling, surface of desk, wall, and floor. It is difficult to distinguish an object from its background in low contrast lighting, particularly in paint stationary workshop or working with print material. Further, Bhusal et al (na) described the color qualities of a light source by two attributes: color rendering and color temperature. The choice of color appearance itself is a matter of psychology, aesthetics and natural tendency. In warm climates generally a cooler light color appearance is preferred, whereas in cold climates a warmer light color appearance is preferred.

Those findings also linear with the study of Mills et al. (2007) that high correlated color temperature fluorescent lights could provide a useful intervention to improve wellbeing and productivity in the corporate setting, although further work is necessary in quantifying the magnitude of likely benefits. Study of Hoffman et al (2008) also gain the similar

result that variable of light exerts a potential advantage in indoor office accommodation with respect to subjective mood. And even, the cultural and geographical differences influence the mood at work regarded the color of lighting. Study of Küller et al. (2006) had found that in the far north of the equator countries there was a significant variation in psychological mood over the year that did not occur in the countries closer to the equator. The workers' mood was at its lowest when the lighting as much too dark. The mood then improved and reached its highest level when the lighting was experienced as just right, but when it became too bright the mood declined again.

Figure 1 from the study of Skansi (2012) shows several dimensions in lighting which need to be considered on ergonomic study on light and visual at workplace. In term of color, light color take an important place that influence visual environment on workplace. While, color rendering influence visual comfort. Both were determine the level of illumination which influence to human performance at work.

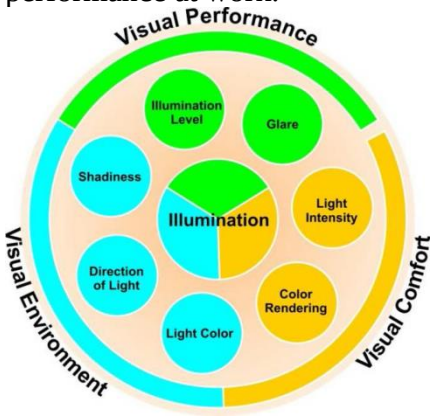

Figure 1. Diagram of light dimensions and visual aspects

Further, Skansi (2012) also mentioned that colors affect the emotion of human, particularly in workplace. For example, red color represent power, energy, passion and fast action. While, blue is identical to depth, calmness, cleanliness and harmony. Other color is white which can be identified as purity, precision, and sterility. Otherwise, orange color is identical to enthusiasm, warmth and creativity. And the purple is associated with luxury, transformation, and free of mind. Study of Ho et al. (2014) found that color also influence the judgment toward object. A Blue object is more likely to be judged as warm than the red object of the same physical temperature.

According to the above theoretical review, lighting, particularly in color, impact human behavior on workplace. So, the first hypothesis can be formulated that there is a difference on the performance (Working Efficiency, Working Motivation, and Level of Concentration) depend on the color of the light, in term of white, blue and pink color of lighting. Due to the context of work needs to be considered related to the accuracy of the light color selection (IAPA, 2008), then the second hypothesis predicted that there is a difference on the performance (Working Efficiency, Working Motivation, and Level of Concentration) within subjects of experiment. Whereas, in the term of gender, Knez and Enmarker (1998) stated that gender influence on mood and cognitive performance at workplace that related to the choice of office lighting. So, the last hypothesis predicted that there is a difference between group of gender and experimental condition.

RESEARCH METHODOLOGY

Participants

Participants were students of Hochschule Niederrhein, Krefeld. Fourteen women and 10 men participated. Their ages ranged from 20-50 years (M=35.7; median=34), and their educational backgrounds ranged from diplomas to bachelor degrees. The participants were paid 5 Euro to 30 Euro voucher of Saturn for their participation in one hour session of this experiment.

Setting

The experiment performed from 08th to 12th August 2016 and took a place in Human Factor Laboratory at Human Factor Engineering Department, Hochschule Niederrhein. Figure 1 shows one facility which consisted of ca. 2 m x 2 m windowless-cubes and used as the main room for experiment. Wall painting, one chair and one circle desk were in white to optimize visual focus on object concerning the lighting. The carpet was in dark color, but actually were not visible to the respondent when seated. The lighting instrument placed in the ceiling of cubes which is operated from the outside by lighting software application.

Figure 2. Cube design for lighting experiment and position of lighting instrument

Figure 3. Lighting software and its hardware support

Materials and Measures

The sets of information were presented by narrative instruction which need to be followed by the respondent on this experiment. Combining two material and difference of lighting color were used as the assignment. First, a set of puzzles that can be arranged according some figures (*see figure 3)*. Second, a power test with paper and pencil model. Both were carried out and measured for its efficiency performance on this experiment. The measuring used a short-term mental work-strain scale or *Schätzskalen zum*

kurzfristigen Beanspruchungserleben (SKB-Verfahren) from Hacker et al. (2012). Two meaningful factors which to be measured were performance efficiency and achievement motivation. Otherwise, for puzzles measured by its performance of completeness.

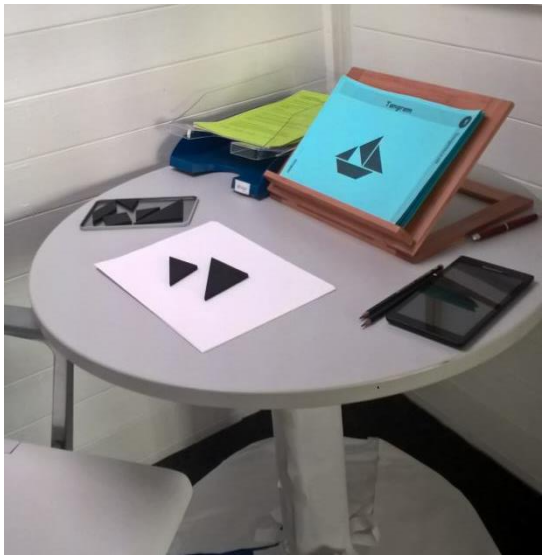

Figure 4. A set of puzzle as one of the assignments.

Procedures

First of all, the respondents fill out a questionnaire about their background of demographic and consuming behavior. The respondents then started working on two types of assignments which given by variations of light colors, namely white as a baseline and combination of white, pink and blue colors. Before and after carrying out the first assignment, the respondents fill out the short-term mental work-strain scale or SKB. While for the second assignment the speed of completeness and its correctness were evaluated as the level of concentration.

Table 2 shows the procedure that is designed for this experiment.

Table 2: Experiment Design

	T0 (Pretest)	T1 (White Color)	T2 (White-Blue-Pink Color)
Assignment 1	SKB 0	SKB 1	SKB 2
Assignment 2	-	d1	d2

Statistical Analyses

This research put performance as dependent variable which characterized as performance efficiency (1), achievement motivation (2), and concentration of work (3). Experiment design was performed on this research. Several manipulation as independent variables will be performed and examined its influence to the dependent variable. The manipulation of colors of light is considered as independent variable because it is assumed to be varied independently of any other variable (Howwit & Cramer, 2011). This research also referred to within-subject design where the same participants take part in all assignments or conditions. The advantage of this design is that many differences between participants effectively managed and control. Statistical analysis was carried out using SPSS for windows version 22 for data processing and answering the hypothesis. Single-factor analysis of variance (Anova) was utilized to answer the difference between independent variables: performance efficiency, achievement motivation, and concentration of work. One Factorial Analysis was executed to measure the difference within-subject of assignment, and Two Factorial Analysis for between-subject.

RESULT

Descriptive Statistic

25 respondents were participated on this experiment. Table 3 shows that most of respondents were female. 56% of respondents were in group of age between 12 and 26 years old. 56% of respondents had not drank a coffee and 88% had not a

meal before participating on the experiment. Only 16% of respondents who have habit of smoking. 60% of respondents claimed that have no eye restrain which need to use glasses. In experiment timing, most of respondents performed at noon. And in the term of experimental condition, both of white-white and white-pink group had been followed by 36% of respondent, while group of white-blue only 28%.

Table 3: Demographic Characteristic of The Respondents

		Frequency	Frequency Percentage (%)
Gender	Male	10	40%
	Female	15	60%
Age	12 to 25 years	14	56%
	26 to 50 years	11	44%
Drinking Coffee*	Yes	11	44%
	No	14	56%
Eating*	Yes	3	12%
	No	22	88%
Smoking Status	Yes	4	16%
	No	21	84%
Using Glasses	Yes	10	40%
	No	15	60%
Experiment timing	Morning	7	28%
	At noon	10	40%
	Evening	8	32%
Experimental Conditions	White-White	9	36%
	White-Blue	7	28%
	White-Pink	9	36%

Comparing mean score on Table 4 can be identified the difference level between variables. In the context of gender, female respondents had higher level of concentration than male. Whereas, participants with age 12 to 25 years had higher level of concentration compared to respondent with 29 to 50 years old. Interesting finding in coffee drinking showed that respondent with coffee consumption had higher level of concentration then respondents who no drink coffee. While on the light condition, white-white color had highest level of concentration.

Table 4: Descriptive Indexes

			Mean	SD
Gender	Concentration 1	Male	169.60	27.885
		Female	186.60	34.174
		Total	179.80	32.328
	Concentration 2	Male	192.600	37.763
		Female	208.067	37.006
		Total	201.880	37.328
	Working Motivation 2	Male	-.6333	.82327
		Female	-.7556	1.21150
		Total	-.7067	1.05550
Age	Concentration 1	12 to 25 years	186.29	33.639
		26 to 50 years	171.55	30.054
		Total	179.80	32.328
	Concentration 2	12 to 25 years	211.071	38.726
		26 to 50 years	190.182	33.552
		Total	201.880	37.328

Drinking Coffee	Concentration 1	Yes	183.27	203.909
		No	177.07	32.733
		Total	179.80	32.328
	Concentration 2	Yes	203.909	37.903
		No	200.286	38.224
		Total	201.880	37.328
Experimental Conditions	Concentration 1	White-White	186.89	21.624
		White-Blue	174.86	33.409
		White-Pink	176.56	41.723
		Total	179.80	32.328
	Concentration 2	White-White	216.220	23.868
		White-Blue	207.286	40.897
		White-Pink	183.333	41.379
		Total	201.880	37.328
Experimental Conditions	Performance Efficiency 0	White-White	-.6296	1.03942
		White-Blue	-1.2905	.97842
		White-Pink	-.3204	.90253
		Total	-.7033	1.01418
	Performance Efficiency 1	White-White	-1.2667	.67823
		White-Blue	-.6262	.96570
		White-Pink	-.0259	1.00820
		Total	-.6407	1.00699
	Performance Efficiency 2	White-White	-.3704	1.11896
		White-Blue	-.4429	.98933
		White-Pink	.0278	.82466
		Total	-.2473	.96641
Experimental Conditions	Achievement Motivation 0	White-White	-1.6296	.96385
		White-Blue	-1.5238	.99735
		White-Pink	-1.1852	1.52854
		Total	-1.4400	1.17347
	Achievement Motivation 1	White-White	-1.4444	.70711
		White-Blue	-1.5714	.68622
		White-Pink	-1.2222	1.30171
		Total	-1.4000	.93294
	Achievement Motivation 2	White-White	-.2593	.95420
		White-Blue	-.9524	.82616
		White-Pink	-.9630	1.25216
		Total	-.7067	1.05550

Hypothesis 1

Table 5 shows the finding regarded to the first hypothesis: are there differences on the performance (Working Efficiency, Working Motivation, and Level of Concentration) depend on the color of the light, in term of white, blue and pink color of lighting.

Table 5: Analyses of Varians between dependent variables

Source		Type III Sum of Square	Df	Mean Square	F	Sig.
Level of Concentration_2	Between Group	5151,656	2	2575,828	2,003	,159
	Within Group	28290,984	22	1285,954		
	Total	33442,640	24			
SKB_Working Efficiency_2	Between Group	1,085	2	,543	,560	,579
	Within Group	21,330	22	,970		

	Total	22,415	24			
SKB_Working Motivation_2	Between Group	2,815	2	1,408	1,295	,294
	Within Group	23,922	22	1,087		
	Total	26,738	24			

The result indicates that there is no difference on the Working Efficiency (SKB), Working Motivation (SKB) and Level of Concentration (d2) depend on the types of the light color on the second session of experiment (T2). Thus, the first hypothesis is refused.

Hypothesis 2

Table 6: Tests of Within-Subjects Effects for Variable of Level of Concentration (d2)

Source		Type III Sum of Square	Df	Mean Square	F	Sig.
Total	Sphericity Assumed	6094,080	1	6094,080	36,051	,000
	Greenhouse-Geisser	6094,080	1,000	6094,080	36,051	,000
	Huynh-Feldt (HF)	6094,080	1,000	6094,080	36,051	,000
	Lower-bound	6094,080	1,000	6094,080	36,051	,000
Error	Sphericity Assumed	4056,920	24	169,038		
	Greenhouse-Geisser	4056,920	24,000	169,038		
	Huynh-Feldt (HF)	4056,920	24,000	169,038		
	Lower-bound	4056,920	24,000	169,038		

Table 7: Tests of Within-Subjects Effects for Variable of Working Efficiency (SKB)

Source		Type III Sum of Square	Df	Mean Square	F	Sig.
Total	Sphericity Assumed	3,055	2	1,527	3,802	,029
	Greenhouse-Geisser	3,055	1,795	1,702	3,802	,034
	Huynh-Feldt (HF)	3,055	1,930	1,583	3,802	,031
	Lower-bound	3,055	1,000	3,055	3,802	,063
Error	Sphericity Assumed	19,282	48	,402		
	Greenhouse-Geisser	19,282	43,069	,448		
	Huynh-Feldt (HF)	19,282	46,327	,416		
	Lower-bound	19,282	24,000	,803		

Table 8: Tests of Within-Subjects Effects for Variable of Working Motivation (SKB)

Source		Type III Sum of Square	Df	Mean Square	F	Sig.
Total	Sphericity Assumed	8,501	2	4,250	5,539	,007
	Greenhouse-Geisser	8,501	1,710	4,972	5,539	,010
	Huynh-Feldt (HF)	8,501	1,828	4,651	5,539	,009
	Lower-bound	8,501	1,000	8,501	5,539	,027
Error	Sphericity Assumed	36,833	48	,767		
	Greenhouse-Geisser	36,833	41,032	,898		
	Huynh-Feldt (HF)	36,833	43,866	,840		
	Lower-bound	36,833	24,000	1,535		

The result on Table 6 indicates that there is a difference on the level of concentration (F: 36.051; *p: 0.01)* within subject. Table 4 shows that level of concentration on T2 or d2_2 (*mean: 201.880; SD: 37.328)* is higher than T1 or d2_1 (*mean: 179.80; SD: 32.328*). On the variable of working motivation, table 7 shows that there is a difference (F: 5.539; *p: 0.01)* within subject (SKB_0, SKB_1 and SKB_2). Table 4 shows that working efficiency on T2 or SKB_2 (*mean: -.2473; SD: .96641)* is higher than on T1 (*mean: -.6407; SD: 1.00699)* and T0 (*mean: -*

.7033; SD: 1.01418). Whereas, table 8 describes that there is a difference (F:5.539; *p: 0.01)* on the variable of working motivation within subject (SKB_0, SKB_1 and SKB_2). Table 4 shows that working motivation on T2 or SKB_2 (*mean: -.9630; SD: 1.25216)* is higher than on T1 (*mean: -1.4000; SD: .93294)* and T0 (*mean: -1.4400; SD: 1.17347*). Thus, the second hypothesis was supported.

Hypothesis 3

Table 9: Test of Between-Subjects Effects for Variable of Concentration_T2 (d2-2)

Source	Type III Sum of Square	Df	Mean Square	F	Sig.
Corrected Model	7174,533[a]	5	1434,907	1,038	,424
Intercept	850368,842	1	850368,842	615,081	,000
Experimental Condition	3005,870	2	1502,935	1,087	,357
Gender	1072,166	1	1072,166	,776	,390
Experimental Condition * Gender	1157,983	2	578,991	,419	,664
Error	26268,107	19	1382,532		
Total	1052331,000	25			
Corrected Total	33442,640	24			
a. R-Quadrat = ,215 (Adjusted R-Quadrat = ,008)					

Table 10: Tests of Between-Subjects Effects for Variable of Working Efficiency_T2 (SKB)

Source	Type III Sum of Square	Df	Mean Square	F	Sig.
Corrected Model	1,760[a]	5	,352	,324	,892
Intercept	2,066	1	2,066	1,900	,184
Experimental Condition	1,269	2	,635	,584	,567
Gender	,006	1	,006	,005	,943
Experimental Condition * Gender	,666	2	,333	,306	,740
Error	20,655	19	1,087		
Total	23,944	25			
Corrected Total	22,415	24			
a. R-Quadrat = ,079 (Adjusted R-Quadrat = -,164)					

Table 11: Tests of Between-Subjects Effects for Variable of Working Motivation_T2 (SKB)

Source	Type III Sum of Square	df	Mean Square	F	Sig.
Corrected Model	4,358[a]	5	,872	,740	,603
Intercept	12,390	1	12,390	10,519	,004
Experimental Condition	1,716	2	,858	,728	,496
Gender	,473	1	,473	,402	,534
Experimental Condition * Gender	,922	2	,461	,391	,681
Error	22,379	19	1,178		
Total	39,222	25			
Corrected Total	26,738	24			
a. R-Quadrat = ,163 (Adjusted R-Quadrat = -,057)					

Table 9 shows that there is a difference in level of concentration regarded the experimental condition and gender (F: 615.081;*p: 0.01).* In

combination with Table 4, female (*mean: 208.067; SD: 37.006)* has higher level of concentration than male (*mean:192.600; SD: 37.763)*. Whereas, Table 10 indicates that there is no difference on working efficiency regarded experimental condition and gender. Last, Table 11 describes that there is a difference on the working motivation (F: 10.519; *p: 0.01)* regarded the experimental condition and gender. Combining with Table 4, male (*mean: -.6333; SD: .82327)* has higher working motivation than female (*mean: -. 7556; SD: 1.21150)*. Thus, not all predictions on the third hypothesis was supported.

DISCUSSION

The result of this experimental study in general showed that color in lighting could impact to performance at work, though on the type of work no exist any difference. Further, that result indicated that the level of performance, in term of working concentration, working efficiency and working motivation, were increased regarded to the change of color of lighting: white to white-blue-pink color. Another result also indicated that in the context of gender, female had higher level of concentration than male. Otherwise, male has higher level on working achievement than female. There is no difference in both on the working efficiency.

Results of this study were consistent with the previous study on the impact of lighting to the work behavior. Together with the level of illumination, color of lighting could influence the emotion as part of mental model on working (Vischer, 2008; Hameed & Amjad, 2009; Bhusal et al., *na;* Mills et al, 2007; Kuller et al., 2006; Hoffman et al. 2008). Choosing the pink color could contribute the new information to the research on light and human performance, since research on this issue generally used the warmth and cool bright light. As it mentioned before that color represent as symbols of human emotion, such as red color for energy and competitiveness, blue color for coolness and calmness, green as healthy and safety, and yellow as happiness and creativity (Skansi, 2012).

The first practical implication of this study could be related to the type of works. According to OSH Brief No. 3C (table 1) that working with fine detail required the minimum level of illumination, but not in type of lighting color. Thus, several work activities predicted required a specific lighting color at its work environment, such as working with chemical material would be better with neutral color, for example white lighting. While, job of accounting might be better with soft blue light Second, the implication of color in lighting might be enhanced to the others context of work or business beside indoor working environment, such as in consumer behavior (Paul et al., 2014), automotive design (Pena-Garcia et al., 2014), education environment (Bellia et al., 2015), traffic and road design (Skansi, 2012).

Several general lesson learned are worth noting on this study. First, existing of control group or conducting repetition measurement could lead to the more robust in finding. Comparing between group of intervention and group of control resulted the value that could indicated the truly impact of intervention. Second, increasing value of each step of assignment actually indicated several of the weakness of within-subject design in this experiment, mainly on the effect of practicing. The participants may become better at the task they are carrying out (Howwit & Cramer, 2011). So, the participants make may be less mistake in the second than in the first condition. So that, in a within-subject design, every effects as a result of doing the conditions in a particular order need to be controlled.

REFERENCES

AIRMID Health Group (na). Lighting Within the Workplace. *Presentation.* Retrieved on November 28th 2016 from

http://www.airm.ie/system/download_images/18/original/Noise%20and%20Light.pdf?1316618431

Assaf, D. A. M. & Alswalha, D. A. (2013). Environmental Impacts of Working Conditions in Paint Factories Workers in The Hashemite Kingdom of Jordan (Field Study). *European Scientific Journal March*, Vol. 9, No. 8, pp. 193-205. Retrieved from on November 28th 2016 http://search.proquest.com/openview/9694ee25cf00b1e655da552bacc6244c/1?pq-origsite=gscholar

Belliaa, L., Spadaa, G., Pedacea, A., & Fragliassoa, F. (2015) Methods to evaluate lighting quality in educational environments. *Energy Procedia*, 78: pp. 3138 – 3143.

Bhusal, P., Tetri, E., & Halonen, L. (*2006*). Quality and Efficiency of Office Lighting. . Retrieved on on November 28th 2016 from http://www.aivc.org/sites/default/files/members_area/medias/pdf/Inive/epic2006/Volume_2_Epic06/E13/083_Bhusal.pdf

Doherty, A. R., Kelly, P., O'Flynn, B., Curran, P., Smeaton, A. F., O'Mathuna, C., & O'Connor, N. E. (2010). Effects of Environmental Color on Mood: A Wearable Life Color Capture Device. *MM'10.* Retrieved on November 28th 2016 from http://doras.dcu.ie/15994/1/de24121-doherty.pdf

Hacker, W., Hubrich, A., Morgenroth, T., & Stab, N. (2012). Schätzskalen zum kurzfristigen Beanspruchungserleben (SKB-Verfahren) – modifiziert nach Plath & Richter (1984). *Psychology of Everyday Activity*, Vol. 5. Retrieved on November 28th 2016 from http://www.allgemeine-psychologie.info/cms/images/stories/allgpsy_journal/Vol%205%20No%201/Hacker_etal.pdf

Hameed, A. & Amjad, S. (2009). Impact of Office Design on Employees' Productivity: A Case Study of Banking Organization of Abbottabad, Pakistan. *Journal of Public Affairs, Administration and Management.* Volume 3, Issue 1, pp. 1-13. Retrieved on November 28th 2016 from *http://www.scientificjournals.org/journals2009/articles/1460.pdf.*

Ho, H-N., Iwai, D., Yoshikawa, Y., Watanabe, J., & Nishida, S. (2014). Combining Color and Temperature: A Blue Object is More Likely to be Judged as Warm Than A Red Object. *Scientific Reports*, 4: 5527. Doi: 10.1038/srep05527

Hoffmann, G., Gufler, V., Griesmacher, A., Bartenbach, C., Canazei, M., Staggl, S., & Schobersberger, W., (2008). Effects of Variable Lighting Intensities and Color Temperatures on Sulphatoxymelatonin and Subjective Mood in An Experimental Office Workplace. *Applied Ergonomics,* 39, pp. 719-728. Doi:10.1016/j.apergo.2007.11.005

Howitt, D. & Cramer, D. (2011). Introduction to Research Methods in Psychology: Third Edition. Harlow: Pearson Educated Limited

Industrial Accident Prevention Association. (2008). Lighting at Work. *A Health and Safety Guideline for Your Workplace.* Retrieved on on November 28th 2016 from http://www.iapa.ca/pdf/lightin.pdf

International Labor Organization. (*na*). Physical Hazards Indoor Workplace Lighting. *OSH Brief No. 3c*, pp. 1-6. Retrieved on November 28th 2016 from http://www.ilo.org/wcmsp5/groups/public/---americas/---ro-lima/---sro-port_of_spain/documents/presentation/wcms_250198.pdf

Kakooei, H., Rahimi, M. D., & Hosseini, M. (2009). The Role of Bright Light during Night Work on Stress and Health Status of Shift Work Nurses.

International Journal of Occupational Hygiene. 1, pp. 46-50. Retrieved on November 26th 2016 http://ijoh.tums.ac.ir/index.php/ijoh/article/viewArticle/8

Knez, I. & Enrmarker, I. (1998). Effects of Office Lighting on Mood and Cognitive Performance And A Gender Effect in Work-Related Judgement. *Environment and Behavior,* 30 (4), pp. 553-567. Retrieved on November 28th 2016 from http://eab.sagepub.com/content/30/4/553.full.pdf+html

Knez, I. & Kers, C. (2000). Effects of Lighting, Gender, and Age Effects of Indoor Lighting, Gender, and Age on Mood and Cognitive Performance. *Environment and Behavior*, vol. 32, No. 6, pp. 817-831. Retrieved on November 28th 2016 from http://eab.sagepub.com/content/32/6/817.full.pdf+html

Küller, R., Ballal, S., Laike, T., Mikellides, B., & Tonello, G. (2006) The impact of light and color on psychological mood: a cross-cultural study of indoor work environments, Ergonomics, 49:14, 1496-1507, DOI: 10.1080/00140130600858142. Retrieved on November 28th 2016 from https://www.researchgate.net/publication/6746144_The_impact_of_light_and_color_on_psychological_mood_A_crosscultural_study_of_indoor_work_environments

Mills, P. R., Tomkins, S. C., & Schlangen, L. JM. (2007). The Effect of High Correlated Color Temperature Office Lighting on Employee Wellbeing and Work Performance. *Journal of Circadian Rhythms*, **5**:2. Doi:10.1186/1740-3391-5-2. Retrieved on November 28th 2016 from http://www.jcircadianrhythms.com/articles/10.1186/1740-3391-5-2/

Paul, C. G., Paulette, H., Hyun-joo, L., Mihyun, K., Yeasun, C., Jerrold, L., & Lisa, S. (2014). Seeing the Light: Consumer Perceptions of Ground Beed Packages. *Management*, 4(4): pp. 77-89. DOI: 10.5923/j.mm.20140404.01

Pena-Garcia, P., Espin, A., De Ona, J., & Pena-Garcia, A. (2014). Considerations on the Effects of Automotive Lighting to Enhance Alert and Avoid Sleepiness in Night Time Drivers via Melatonin Inhibition. *Procedia Engineering*, 84: pp. 608 – 612.

Skansi, R. (2012). Ergonomics of Light. *GE Lighting.* Retrieved from http://www.hdr-cie.hr/radovi/RS_13.pdf

Viola, A.U., James, L.M., Schlangen, L.J.M., & Dijk, D-J. (2008). Blue-enriched White Light in the Workplace Improves Self-Reported Alertness, Performance and Sleep Quality. *Scand J Work Environ Health,* vol 34 (4), pp. 297-306. Retrieved on November 28th 2016 from https://www.ncbi.nlm.nih.gov/pubmed/18815716

Vischer, J. C. (2008). Toward an Environmental Psychology of Workplace: How People are Affected by Environments for Work. *Architectural Science Review*, vol. 51.2, pp. 97-108. Retrieved on November 28th 2016 from http://www.seedengr.com/An%20Environmental%20PsychologyOf%20Work-space.pdf

Woo, J-M. & Postolache, T. T. (2008). The Impact of Work Environment on Mood Disorder and Suicide: Evidance and Implication. *International Journal Disability Human Development;* 7 (2), pp. 185-200. Retrieved on November 28th 2016 from https://www.ncbi.nlm.nih.gov/pmc/articles/PMC2559945/pdf/nihms52245.pdf