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Effects of Luminous Furniture on Mood

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Abstract

Psychological lighting research mostly deals with light effects of lighting, which are above eye-level. This research explores the effects light of a luminous furniture on customer's mood. A laboratory experiment and quasi-experimental method were conducted. The first experiment was intended to identify two variables of a luminous furniture. The quasi-experiment evaluates various effects of lights of two sets of a café luminous furniture. In this experiment, seventy students were involved to report their feelings toward three different luminous furniture settings. The data was analyzed using ANOVA statistic. The result shows that the constant setting of a luminous furniture was the most favorable in influencing people's mood.

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Keywords: Luminous furniture; interior lighting; dining space; mood

1. Introduction

Human needs sunlight to grow, survive and keep healthy. However, every group of a population may expect daylight exposure differently to one another. Some may expect less exposure to daylight than the other because of different geographical characteristic they live in relation to yearly sun altitude. Some other may call for a different portion of sun exposure to get the benefit of it. In fact, excessive exposure to sunlight may be harmful to health. Such biological needs of human to daylight seem to give effect to their

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psychological dependence on sunlight to achieve a complete state of health. According to WHO, healthy individual is achieved when one is physically, mentally and socially well performed. In order to maintain such condition, people who often feel stress from working or any other daily routine activities would regularly seek places for health restoration. In response to this, researchers or design scientists continually explore prospective elements from the environment including light sources that have a capacity to restore human behavioural problems.

Interestingly, it has been obvious that human feel good and perform better work when they have access to daylight either through windows or other openings of the building. The changes of light quality throughout the day can influence people's behavior. Some people who have prolonged lack of daylight could suffer from seasonal affective disorder (SAD), and a specific therapy using artificial light has been created to respond to such illness. Such daylight-human dependency prompts people to keep finding ways in the use of the artificial source of light to create specific effects of light, which can represent the true nature of daylight. This effort is highly relevant for those who are less or not at all exposed to daylight and need a particular quality of lighting to support their daily or routine activities. It may also associate with those who need restorative effect of light to solve their behavioural problems. For instance, this occurs because of geographical constraint or building characteristic that they live in like people who live or work in a basement or other space that is far from the windows. After working the whole week in the bright light office, people may need to do relaxation by spending some time in a café; that applies a low level of illumination. Therefore, various approaches to designing lighting effect have been explored to respond to such needs. Previous studies on the function of interior lighting in meeting the need for acquiring positive emotion have been conducted. For instance, People like to see lighted wall surfaces better than being in a lighted area (Veitch, 2001). Essentially, studies on the manipulation of artificial light to create various effects of daylight to expect more positive behavioural responses are becoming crucial. This trend occurs because people may have opportunity to face a health problem from an ineffective metabolism, as a result of uncertain hormone (plasma melatonin and cortisol) production problem. Huge lighting industry like Philips has great interests in developing lighting fixture to replicate various effects of light to meet more complex function of lighting. Mimicking the effects of sunlight with artificial lighting would be very challenging, because, its quality may seem countless in number. As well, it is sometimes unpredictable in terms of how people can appreciate its presence. Daniel Rybakken, Norwegian young designer's predicts that people sometimes feel the effect of sunlight subconsciously.

However, in so far, there are no studies that explain whether customers feel differently in response to the effect of lighting on a different location in the room, with reference to the customer's eye level. Therefore, systematic investigations are needed to be able to discover and define new quality effect of light that can meet human particular needs of lighting. This project investigates whether the differentiating location of lighting source in café interiors can affect the observers' moods.

2. Literature study

2.1. Moods as predictor of consumer behavior

Moods relate to emotion. However, it is not like emotion where some persons can have the same emotion because of a certain event. People experience a specific mood personally. According to McCloughan et. al. (1998), moods are defined as subjective expressions of a person's basic feelings at a certain point in time. It can turn out to a person carry out a simple daily activity. People may have a bad mood just because they did not get enough sleep or are having psychological problem like depression or stress, or health problem. In such situation, people often suffer negative moods (i.e. anxiety, depression), which usually discourage them from doing other daily activities, like eating, going out or meeting friends.

As people can have good or bad moods because of an uncertain reason, they are not able to explain why this feeling occurs. Therefore, sometimes in such situation people express it interchangeably with affective or emotions.

Some studies relate moods to the way people think, imagine or solve problems. Positive moods are believed to make people think more flexibly and creatively. Complementing this finding, Vosburg (1998) proved that good moods improved subjects' task performance significantly compared with that in bad moods. In fact, moods are separated from motivation and cognition. The interaction of these issues have long been studied and a debate among psychologists. Since moods can direct and influence what people think, judge and behave in response to anything or environment, questions of what factors can change consumer's mood become crucial. This notion is important for those concerned with providing services or products for targeted consumers. For instance, café owners who provide places for people to enjoy foods and drinks need to know how to create an atmosphere, which make people feel good and complement their positive mood. Therefore, although people can be in a bad mood even before they interact with a new environment, we can still expect that it would make people smile and support their mood. Thus, it is relevant to explore the elements of an environment that can please people while performing an activity.

2.2. Environmental impact on mood

Psychologists found that human effort to reach happiness depend on three of five factors that base human personalities. These factors include: " extraversion (outgoing, active); neuroticism (moody, and nervous); and conscientious (forward thinking, decisive) (Weiss, 2008). Although human personality and hereditary determine the level of human happiness, other factors including environment would still have effects on human to fill in another part of happiness. In order that an environment can be stimulating for human, its stimuli must be pleasantly perceived by any human sensory modality. Researchers have paid attention to the effects of various stimuli of an environment on mood. Environmental scents have long been produced and widely used in business outlets to make hotel rooms/ lobbies or stores to have a pleasant smell. With such environmental stimuli, the retailers expect them to improve the customers' mood and potentially increase their loyalty (Rahadi, 2011). Similar study done by Chebat and Michon (2003) concluded that customers' perception of the emotionally pleasing scented mall environment was more positive than that without scent. In addition, Bone and Jantrania (1992), as cited by Chebat and Michon (2003) reported that the use of scent to induce customers' mood gave impact to an increase of sales. Especially if its smell was perceptually congruent with the product. In terms of environmental temperature, it was found that its effects on moods were negative as its degree and the humidity inclined (Li, 2014). As this environmental stimulus always relates to the outdoors climatic condition, which people need to consider in carrying out various indoor activities, studies of the effects of a natural environment on moods are always relevant to do. In studying this, Corraliza (2011), reported that nature played a good role in restoring psychological well-being. This notion confirmed Kaplan and Kaplan (1989), as the former author cited, stating that natural habitat was the most effective environment to restore people from work stress.

2.3. Mood lighting

Some studies of interior lighting related to moods, well-being or behavior have been done to know what factors of lighting that can give positive impact to the working performance and satisfaction. Many studies of office workers' preference have been done to investigate how static or dynamic lighting support their working throughout the day. McCloughan et al. (1999) researched the combined effects of illuminance levels (high-low) and color correlated temperature (CCT) (cool and warm) to clarify its effect

on mood. They found that an interior with moderate difference in those light variables were supportive for people's moods. Similar study by Knez (1995) and McCloughan et al. (1999) found that lighting with different level of color rendering index, illuminance level, color temperature had a different impact on people's mood. The different effect also occurs across age and gender difference. Women's negative mood diminished under lighting with warm correlated color temperature (2950K), whereas men's negative mood diminished under lighting with cool correlated color temperature. Vogels (n. d) found that people's mood, behavior and well-being can change under different quality of interior lighting.

In so far, people have been accustomed to experiencing a variety of atmosphere supported by the source of lights radiating from the overhead lighting armature either for functional or more decorative objectives. Enormous overhead lighting designs have been created to result in various effects of lights as a result of different distribution of light and specification of light source. Most studies on lighting related to its positive or negative psychological effect on people confined to those aspects of light. For instance, an experiment by Ciani (2010) aimed to see whether the changing of restaurant colour temperature from a cool colour to warmer would give pleasurable effects to the customers. More specific findings on such issue showed that the ambient effect resulted from bright light using an incandescent lamp brought about positive emotion on people (Xu and Labroo, 2013). Wardono et al. (2011) also studied the combination of warm interior lighting, colour and decoration to know its effects on social dining behaviour for people dining with a friend compared to that with a special friend. The results showed that the combined effect of a dim lighting using fluorescent lamp (5000lm), a monochromatic colour scheme and simple décor was supportive for customers' emotion, especially while eating with a special friend.

From this review, it confirms that mood lighting researches concerning the location of light sources seem to be very limited. Therefore, the lights radiating from luminous furniture, which are bellow eye level, is interested to explore, and we raise some questions as follows. How should furniture be designed in order that the light emitting from the bottom of it is effective to stimulate affective response? How should luminous furniture work in terms of its lighting performance in order to have effects on moods?

3. Research method

To carry out this project, we proposed two experiments. The first one aimed to explore a design rattan-weaved chair and table that applies lighting system inside in order to create light effects relevant to mood improvement, which will be tested in the main experiment. For this experiment, some sorts of illuminated furniture were modelled in a kind of lantern. It applied weaving technique and white cotton fabric cover to expect that the light effects resulted could effectively impress the respondents and give affective response from it. In order that this technique could work effectively, we propose two lantern variables: form (Square and rounded form) and weaving pattern (Vertical and horizontal pattern). This way aimed to explore how the combined effect of these variables could influence affective response or mood. It has been common to know that design elements like these have effects on feeling, pleasure or liking. To prepare this experiment, we designed four kinds of lantern resulted from the combination of two forms: Square and rounded form and two patterns of weaving. These lanterns were presented as the experimental stimulus (See figure 1) to 25 respondents aged between, 19-20 (M=19.6) as if it were experienced in a café for gathering subjects' affective response. The ANOVA statistic analysis showed that none of the lanterns gave a different effect on the samples. It meant that any combination of weaving pattern and form of lantern as the model of a luminous furniture works the same way on the samples' affection ($F(3,96) = .144$, $p = .933$, $r = .004$).

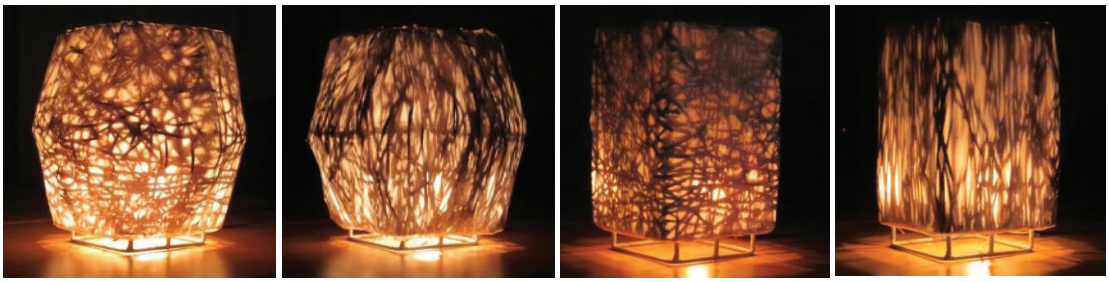

Fig.1. The stimuli of experiment I include four different kinds of lantern(a)Rounded form lantern with rounded weaving pattern; (b)Square form lantern with vertical weaving pattern; (c)Square form lantern with rounded weaving pattern; (d)Square form lantern with vertical weaving pattern

Based on this experiment, we developed two sets of lounge furniture including, four single chairs, two sofas and two tea tables for supporting the second or main experiment. They applied rounded form rattan frame and random weaving pattern (vertical and horizontal) and used polyester fabric as its translucent cover. The use of rattan material for the furniture based on the fact that it looks natural, which is more supportive to the expected light effect of the furniture. Besides, it is flexible material so that any form of furniture could be possibly achieved. Furthermore, it is easily found and largely available in Indonesia.
A LED strip lighting fixture specification used for the furniture was: OSKA3528-60, colour: warm white resin covered lamp, voltage: DC 12 V, IP Code: PU-IP44, LED/m: 60LED, Power: 1m<=4.8W, length: 5m. This LED lamp was set up in each chair and table to make it luminous or illuminated. Each of this luminous furniture connected to one another in such a way and by the use of Arduino software programmable micro-controller they could automatically dim and light up consecutively.

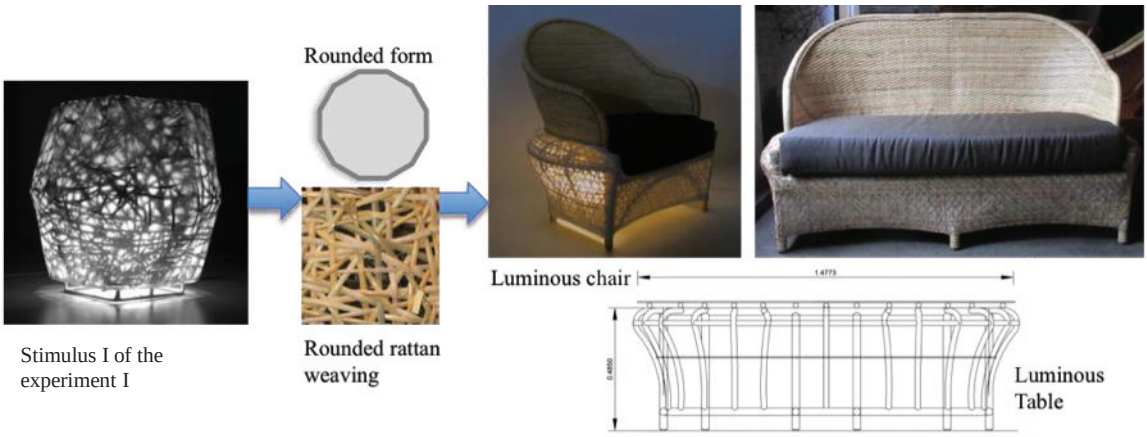

Fig. 2. The design development of luminous furniture

The second experiment applied a quasi-experimental method and took place at one of the dining rooms in "Roemah Kopi" Café, which locates in Rancakendal, Northern area of Bandung, Indonesia. This area is one of a rapidly growing popular culinary shopping destination that many locals and domestic visitors like to visit these days (Astuti, 2010; Hanan, 2012). By using such method, we expect that the subjects' responses toward luminous furniture could result in more natural or valid and reliable data. In the

selection of an experimental dining room, the café owner recommended one that was considered least attractive for the café customers. Because, it fails to facilitate access to view surrounded landscape, which is important for customers, according to Lawson (2013). However, in terms of décor, it still represents the café identity, which is important for respondents' emotional involvement (Ujang, 2010).

In the experimental dining room, two sets of luminous lounge chairs and tables were laid out and set up systematically so that three lighting conditions were able to perform as the experimental stimuli. The first lighting condition was the existing or controlled condition, which applied pendant and table lighting fixture using 25 wattages incandescent bulb (See Fig. 3a). The second lighting condition applied the same room, but the pendant lamp was shut off. Whereas all the set of a lounge luminous furniture was lighted up constantly as high illumination level as 7 lux average around the table (See Fig. 3b). The third lighting condition applied the same condition as the second one. But the lighting was dynamically set up to three groups of the luminous furniture (First group: sofa; second: table; third: single chair). Each of these groups lighted up and dimmed alternately.

Fig. 3. (a)The stimulus of Experiment 2 involves a room in a café with two sets of luminous lounge chair and tables; (b)The existing room using pendant and table lighting fixture with 25 W. incandescent lamp and two sets of luminous lounge chair and tables with the lighting application shut off

Such lighting technique was proposed to refer to the previous research finding that dynamic or pulsating lighting was relevant to the need for positive psychological effect or relaxation (Wan, 2011). A questionnaire to be filled in by the respondents consisted of two types. It included a "mood scale" referring to the emotion scale designed for measuring Positive and Negative Affect Schedule by Watson et. al. (1988). It is based on paired items scaling method, such as: cheerful vs. depressing, relaxed vs. tense, calm vs. anxious, etc. Second questionnaire included a "room choice" ruler, by which respondents gave their attitude toward the experimental room atmosphere after reporting their mood. Respondents' intention to choose a manipulated environment was important to know the commercial status of the room (Arifin et. al., 2011). Citing Wong (2004), Voon (2011) supported this that there was a positive correlation between emotional quality, which customers felt from a service quality (including servicescape) and their loyalty.

To run the experiment 70 students aged between 18-34 (M=22.9) were involved as the respondents. But only eight or less of them were invited to join the experiment at one session according to the numbers of chair used in this experiment. Before the experiment started, the respondents were asked to browse all other dining rooms in order to have a general reference of the café. Then, after the respondents returned to

the experiment room, they were requested to sit and fill in three sets of questionnaire based on three different lighting conditions that were carried out consecutively. In the middle of these sessions, they were served a glass of beverage according to their order from the menu book for free, in return for their involvement as the experiment subjects. After all the respondents had finished the experiment, the data was then analysed using statistic ANOVA to compare the samples' response to three different conditions to identify which lighting condition gave significant impact to one another.

4. The result and discussion

From the data analysis, it shows that there are significant differences in the samples' mood response toward some lighting conditions ($F(2, 207) = 75.239$, $p = .000$, $r = .421$). The samples' mood response toward the second lighting condition is significantly different to that toward the first and third lighting condition. In addition, the samples' response toward the existing lighting condition is also different significantly from that toward the third lighting condition. This finding clearly shows that the samples' response toward the constant mode of lighting of the luminous furniture is most effective to support the samples' mood. In other words, the existing room lighting or the dynamic lighting of a luminous furniture seems not suitable for supporting the samples' mood.

From this result, we can conclude that the luminous furniture using rounded form furniture, random weaving pattern (vertical and horizontal pattern) and polyester jersey fabric cover is effective to support the samples' mood. The dynamic lighting of a luminous furniture did not get a positive response from the samples. Therefore, it is considered not effective to improve the samples' mood. This response value was even far negative than that toward the existing lighting condition. This result seems not consistent with the previous research finding stating that pulsating or dynamic lighting gave positive impact to people's mood.

The most important finding of this experiment is that the use of pendant lamp, which is above eye level, in the existing room condition is not effective to influence customers' affection during dining. Thus, for mood improvement reasons, such lighting technique seems not recommended for a café dining room. Surprisingly, a dining room with light effect radiated primarily from below eye level is found effective to improve affection. As well, it also supported the samples' intention to choose this room for dining, although the lighting illumination level around the tea table was very low or average: 7 Lux. The evidence indicated that it sufficiently supported the guests to see each other and enjoy such atmospheric quality. This evidence also clarifies the study by (1995) and Mcloughan et al. (1999) that different level of illumination has effect on mood. As well, this finding also reconfirms the study by Vogels (n d) that different quality of lighting can change people’s mood.

5. Conclusion

The finding of this research gives evidence of how luminous furniture should be designed. As well, it also explains the question of how the furniture should perform to project its light for mood improvement. Luminous furniture has already been created around, but it is mostly made from artificial translucent material like PVC or acrylic, and yet we had no idea how the illuminated effects of that luminous furniture work in relation to people's feeling. By experimentation, we found an answer, that luminous furniture has a positive effect on mood. Especially when its lighting fixture works in a constant mode or not in a dynamic setting. Besides, such positive effect on people's affection may also relate to the warm look of rattan core and weaving, and cotton fabric used as its cover. This appearance might also reconfirm why Asian lanterns made from bamboo and paper have been in use along with their traditional culture.

This result also supports the fact that people prefer a human material or environment, and the need for this is increasingly critical said Khan (2013).

This new findings complements to the theory that people not only prefer to look at a brighter area, but interestingly they also enjoy sitting in a brighter area illuminated from below or on a luminous furniture. Although the illumination level was relatively low. The negative response of the samples towards the dynamic luminous furniture seemed related to their problem in observing the meal during dining, especially when the lighting was dimming. However, the effects of a luminous furniture on the beverages especially the juice drinks appearance are even interesting because the juice glasses are transparent so that its colored content appears illuminating, and, therefore, more appealing, than if they are illuminated from above eye level.

Therefore, for future research it is recommended that an additional lighting over the table be used to support the need of respondents for dining. Further more, variable of colour rendering of lighting fixture for luminous furniture could be studied for the same purpose, since LED strips provide RGB colour, and the lighting operation of each LED color can also be controlled automatically.

This research may give a new insight in how a lighting and behaviour research is conducted. Especially how light is manipulated by integrating a lighting fixture to furniture since the latest lighting technology allows us to put it in a more limited space and need less energy. Therefore, in the future, a similar way of research by looking at how light is coordinated with other elements in an interior space could be considered and explore its effect on human. So that further explanations on the role of light for better quality of life could be strategically anticipated. We expect that by considering a further integration of light with interior elements, the implications of research to design education and profession could be more promising. As well, as we could predict innovative lighting designs more scientifically, the product development would hopefully be more successful.

However, in doing such research approach, a technical constraint was unavoidable. Because, a new application of lighting fixture, for instance, the use of LED inside a table in this experiment need for an improvisation and some troubles happened as the experiment run. Because, since the electric cable connecting to every chair's and table's lighting fixture were needed, it made the experiment site look a little bit untidy. Therefore, such a situation might be a burdening for the experiment subjects and possibly influenced the response data they gave.

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References

Arifin, et al. (2011). Restaurant's atmospheric elements: what the customer wants. *Journal of ASIAN Behavioural Studies, 1*(2), 33-43.

Astuti, S., & Hanan, H. (2010). The behaviour of consumer society in consuming food at restaurants and cafes. *Journal of Asian Behavioural Studies*. *1*(1), 73-81.

Ciani. (2010). *A study of how lighting can affect a guest's dining experience*. (Unpublished Master's Thesis). Iowa State University, Ames, Iowa, USA.

Corraliza, J. A. (2011). Effects of nearby nature on urban children's stress. *Asian Journal of Environment-Behaviour Studies, 2*(4), 27-37.

Chebat, & Michon. (2003). Impact of ambient odors on mall shoppers' emotions, cognition, and spending a test of competitive causal theories. *Journal of Business Research*, *56*, 529-539.

Hanan, H. (2012). Everyday practices and experiential urban space. *Asian Journal of Environment-Behaviour Studies*, *3*(8), 41-54.

Khan, S. (2013). Research-practice paradigm: an asian perspective. Paper presented in *Asia Pacific International Conference on Environment-Behaviour Studies.* Doi:10.1016/j.sbro.2013.11.005

Knez, I. (1995). Effects of indoor lighting on mood and cognition. *Journal of Environmental Psychology*, *15*(1), 39-51.

Lawson, B. (2013). Design and evidence. Paper presented at *Asia Pacific International Conference on Environment-Behaviour Studies.* doi:10.1016/j.sbspro.2013.11.004

Li, G. (2014). Effects of human mood state in extreme hot environment. *Applied Mechanics and Materials*, 522-524, 541-543.

McCloughan, et al. (1999). The impact of lighting on mood. *Lighting Research Technology*. *31*(3), 81-88.

Rahadi, R. A. (2011, June 15-17). Factors related to repeat consumption behaviour: a case study in traditional market in Bandung and surrounding region. Paper presented at *the Proceedings of ASEAN Conference on Environment-Behaviour Studies.* doi: 10.1016/j.sbspro.2012.03.058.

Ujang, N. (2010). Place attachment and continuity of urban place identity. *Asian Journal of Environment-Behaviour Studies*, *1*(2), 61-76.

Veitch, J. A. (2001). Psychological processes influencing lighting quality. *Journal of Illuminating Engineering Society*, *30*, 124-140

Vogel, I. (n.d). *Atmospheric metrics: Development of a tool to quantify experienced atmosphere in Westerink et al.* (Eds). Probing Experience (pp.25).

Voon, B. H. (2011). Service environment of restaurants: findings from the youth customers. *Journal of Asian Behavioural Studies*, *1* (2), 45-56.

Vosburg, S. K.(1998). The effects of positive and negative mood on divergence –thinking. *Creativity Research Journal*, *11*(2), 165-172.

Wan, S. H. (2011). *An explorative study of the effect of lighting on stress-recovery.* (Unpublished master's thesis). Eindhoven University, The Netherlands performance.

Wardono, et.al (2011). Effects of restaurant interior elements on social dining behaviour. *Asian Journal of Environment Behaviour Studies*, *2*(5), 25-36.

Watson et.al (1988). Development and validation of brief measures of positive and negative affect: The PANAS Scales. *Journal of Personality and Social Psychology*, *54*(6), 1063-1070.

Weiss, A. et al. (2008). Happiness is a personal(ity) thing: the genetics of personality and well-being in a representative sample. *Psychological Science*, *19*, 205-10

Xu, A. J., & Labroo, A. A. (2013). Incandescent affect: turning on the hot emotional system with bright light. *Journal of Consumer Psychology*, *24*, 207-216.