한국심리학회지: 소비자·광고
Korean Journal of Consumer and Advertising Psychology
2018, Vol. 19, No. 2, 329-347
https://doi.org/10.21074/kjlcap.2018.19.2.329

Turn on the light? Turn onto the products?

Minkyo Son **Miyoung Cho** **Gho Kim**†

Dept. of Psychology, Kyungpook National University

Many non-conscious factors are at play in consumer environments such as shopping centers and malls. These non-conscious sensory stimuli can affect consumers' product evaluations. Therefore, this study focused on non-conscious factors to examine whether illuminance level, product type, and gender influence consumers' product evaluations such as psychophysiological responses (Skin Conductance Level, Heart Rate), product attitudes, and purchase intention. The results produce several findings. First, people offered better product evaluations when under a bright light than when under a dimmed light, an effect moderated by product type. Thus, when private products were under a bright light, people displayed high affective responses: they were more aroused and distracted. When public products were under a dimmed light, people showed low product attitudes. Males were more affected by illuminance level than were female participants. This study explored the effects of non-conscious factors on consumers' decision making and produced significant results using the objective approach to product evaluation. These results provide implications for product display and consumer environment design strategies.

Key words : Light, Illuminance Level, Product Type, Gender, Psychophysiological Response, Product Evaluation

† Corresponding author : Gho Kim, Dept. of Psychology, Kyungpook National University, applier@knu.ac.kr

Introduction

Consumer environments such as shopping centers and malls contain abundant sensory stimuli. Consumers pay attention only to a few of them and are hardly aware of the surrounding non-conscious factors, blocking them out (Janiszewski, 1988). However, these non-conscious factors can affect consumers' product evaluations.

Milliman (1982) showed that unconscious environmental responses can affect consumer behavior. According to this study, consumers at a supermarket were affected by music tempo. The consumers who listened to music with a slow tempo spent more time and money at the shopping center than did consumers who listened to fast music. Previous studies on consumers' shopping behaviors have argued that consumers exhibit reasonable and rational decision making when shopping (e.g., Holbrook & Hirschman, 1982); however, recent studies suggest that consumers are sometimes affected by various factors that cannot be processed completely, such as illumination intensity.

Several studies on light have found that illuminance level and lighting color affect people's emotions, cognition, and behavior (e.g., Lambert, Reid, Kaye, Jennings, & Esler, 2002; Kaida, Takahashi, & Otsuka, 2007). Lighting levels usually affect the elicitation of emotional responses and influence decision making and cognitive responses through metaphor (Xu & Labroo, 2014). Light can also affect performance and behaviors, which are based on emotional and cognitive responses (Summers & Hebert, 2001).

Many studies have examined lighting's effects, but they focus on lighting level, ignoring other factors such as product or consumer attributes. We therefore expand previous studies by examining the effects of lighting level, product type, and gender on consumers' emotional and cognitive product evaluations.

Literature Review

Consumers' non-conscious product evaluation

Consumers' decision making and feelings about products are affected by various factors. Consumers pay attention to a few selected factors that relate to themselves or are remarkable stimuli rather than to all the stimuli around them because their attention resources are usually limited (Janiszewski, 1988). Thus, the factors in consumer environments that do not trigger consumers' interest or attention are not processed consciously. Nevertheless, these non-conscious factors sometimes affect them. Non-conscious environmental factors have a decisive effect on emotional and cognitive product evaluations through mechanisms such as embodied cognition, which can stimulate

emotional responses and cognitive processes (e.g., Meyers-Levy, Zhu, & Jiang, 2009; Lee, Rotman, & Perkins, 2014).

'Embodied cognition (EC)' refers to sensory stimuli experienced through the five senses as well as the process that affect our cognitive information process (Lakoff & Johnson, 1999). Various physical senses (e.g., taste, temperature, weight, color, sound) that are perceived through an information process can influence cognitive evaluations and thoughts non-consciously. For instance, people on a soft carpet evaluated a product snugly while people on a hard tile floor evaluated the product pragmatically (Meyers-Levy et al., 2009). These effects of non-conscious factors are reflected in consumption behavior.

In one study, people in cold environments have been found to seek psychological warmth and to select a romantic movie with a warm mood (Hong & Sun, 2012). Similarly, Lee and colleagues (2014) found that temperature affected consumers' product evaluations and purchase intentions: people spent money on social consumption that produced a sense of belonging, thus representing other-directed consumption. People generally think that temperature is related to a social sense of belonging. Therefore, consuming a cool drink led individuals to generate more socially oriented attributes for a hypothetical product, while cooler individuals desired a social consumption setting. Another study found that package size and product color may also affect consumers' choice of product and consumption tendencies (Argo & White, 2012).

Overall, research on the effects of non-conscious factors demonstrates their importance. Therefore, this study will examine the effects of light on consumers' emotional and cognitive product evaluations.

Effects of light

Effects of light on physiological responses

Many studies have examined the effects of light. The typical effect of light is a physiological response. When sunshine touches our skin, our bodies produce Vitamin D, which has been linked to the production of serotonin, a neurotransmitter related to mood (Lansdowne & Provost, 1998).

Furthermore, light is directed to the brain areas that regulate the autonomic nervous system (e.g., Choi, Kim, Kim, Kim, Choi, 2011). The effects of light are mediated by a melanopsin-based photoreceptor, which is highly sensitive to the short wavelength of visible light (Warman, Dijk, Warman, Arendt, & Skene, 2003).

Through these mechanisms, light also elicits acute physiological effects, such as increased alertness (Cajochen, Zeitzer, Czeisler, & Dijk, 2000), heart rate (Scheer, van Doornen, & Buijs, 2004), and sympathetic nerve tone (Sakakibara, Honma, Kohsaka, Fukuda, Kawai, Kobayashi, & Koyama, 2000). Moreover, humans are

particularly sensitive to light; even a light intensity of only 1.5 lux can shift our circadian system (Wright, Hughes, Kronauer, Dijk, & Czeisler, 2001). Thus, light can cause a variety of physiological responses.

Effects of light on emotional responses

As mentioned, sunshine triggers the production of the "feel-good" hormone serotonin. Studies have shown that sunshine inspires people to recover from fatigue and produce serotonin. Many studies have reported the effects of sunshine on emotions (Denissen, Butalid, Penke, & Van Aken, 2008). Furthermore, not only the sunshine but artificial light can also evoke positive emotions. Partonen and Lönnqvist (2000) found that the light from artificial lighting such as incandescent bulbs produces positive feelings and relieves psychological fatigue.

Autonomic nervous system responses evoked by light also affect emotional responses. Such emotional responses have been identified using psychophysiological measurements such as skin conductance level (SCL) and heart rate (HR), which are known to be indexes of anxiety. For example, Smolders and Kort (2014) examined the effects of light on physiological/psychological responses, including physiological arousal, vital level, and performance. They used different levels of illuminance (1000 lx vs. 200 lx). The results showed that people exposed bright light (1000 lx) felt more vital, less sleepy, and a higher physiological arousal level (SCL). These results show the positive effects of bright light on physiological responses and confirm that light can also affect psychological responses. Variations in HR were also investigated in analyses of the effects of light. Choi and colleagues (2011) found that the HRs of people with symptoms of depression or anxiety could change according to type and color of light.

Other studies showed that light leads to physiological and psychological response by evoking responses in the autonomic nervous system, suggesting that light is connected to emotional responses. Xu and Labroo (2014) found that light led to a dramatization of emotion through metaphor. These effects of light occurred because light underlies the perception of heat, which can trigger a hot emotional system (e.g., Ahn, Mazar, & Soman, 2010). Their results showed that ambient brightness makes people feel warm and increases the intensity of their affective response, including sensation-seeking from spicy foods, perceptions of aggression and sexiness in others, and generates more extreme reactions to words and drinks.

Thus, turning on the light can turn on the hot emotional system and raise emotional responses. These results show that light can affect emotional responses.

Effects of light on cognitive responses

Light's cognitive attributes can affect people. As mentioned, the metaphor of light leads to emotional responses and is related to cognitive

responses. On the metaphorical level, some expressions related to high social control and self-perception through others' behavior, such as "to bring to light" and "hidden in the dark," make reference to light and visual perception. These expressions suggest that the sensory experience of light may affect the high cognitive process and that light can elicit the concept of "self" (e.g., Lakoff & Johnson, 1999).

From the empirical perspective, several studies have investigated how lighting conditions change people's feeling of being observed (i.e., perceived anonymity) and their self-awareness (Steidle & Werth, 2014). For example, wearing sunglasses increased participants' subjective feelings of anonymity (Zhong, Bohns, & Gino, 2010); on the other hand, bright light has led to openness and exposure to others (Steidle & Werth, 2014).

On the basis of these results, Steidle and Werth (2014) examined the effects of light on self-awareness and self-regulation. In this study, brightness and darkness levels produced different degrees of self-awareness and self-regulation: bright light elicited more public self-awareness and stronger self-regulation than darkness did. The self-awareness produced by the bright light affected people's preferences: individuals preferred brighter light for public behavior such as working and meeting guests rather than for private behaviors such as listening to music, thinking, and taking a break (Kobayashi, Inui, & Nakamura, 2001). Moreover, when under a bright light, participants with bulimia or an urge to smoke could control themselves through self-regulation (e.g., Kasof, 2002).

Thus, light affects self-awareness, self-control, and self-regulation through the metaphor of light, as suggested by previous studies (Steidle, Hanke, & Werth, 2013). Ultimately, the relevant studies suggest that light leads to different cognitive responses according to its level.

Light and consumer behavior

Light leads to various physiological, emotional, and cognitive responses according to its level. These effects impact consumer behaviors. Areni and Kim (1994) examined the impact of in-store lighting manipulation on shopping behavior utilizing a convenience sample of 171 wine store consumers, who examined and handled significantly more items and purchased more wine under bright lighting than under soft lighting. However, consumers under the soft lighting bought more expensive wine and stayed longer. These results show that lighting level may affect consumers' evaluations.

Similarly, Summers and Hebert (2001) examined the effects of light according to store type. Supplemental lighting was temporarily installed and manipulated on merchandise displays at two retail stores (a hardware and apparel/feed store) to test the effects on consumer behavior in terms of time at display, number of item touched, and number of items

picked up. The results showed that consumers spent more time and touched more frequently at the hardware store than at the apparel/feed store under the bright light, suggesting that the effects of light are mediated by store type and that there are relationships between lighting level and product type.

Product type

There are many ways to classify product types or attributes. The common product type classification criteria are based on the meaning of the product. These criteria include whether the product is hedonic or practical. Hedonic products provide self-image or an experience rather than efficiency, whereas utilitarian products can be divided according to specific and objective evaluation standards (Holbrook & Hirschman, 1982). Other product type classification criteria are based on involvement, defined as consumer attention or perceived importance. A product can be high or low involvement; the former inspire much interest and information, while the latter are purchased with little effort or interest.

Among the many product type classification criteria, this study focuses on the product types based on the consumption situation or openness to others: public and private products (Browne & Kaldenberg, 1997). Many studies have employed the public vs. private criterion. Usually, public products are used among many people, and private products are used alone. Studies have shown that public and private products differ in terms of responses to advertising and product evaluations (e.g., Johar & Sirgy, 1991). Differences in evaluation according to product type emerged through self-conception or a cultural gap (e.g., Zhang, Feick, & Price, 2006).

As mentioned, the metaphor of light can affect consumers' self-conceptions; bright lighting increases public self-awareness and self-regulation (Steidle & Werth, 2014). Public and private products are product types that are related to self-concept. Therefore, self-conceptions evoked by light can affect product evaluations. Bright light makes people prefer private spaces and activities such as reading alone, while dimmed light or darkness makes people prefer public situations. Thus, we expect that there are differences in product evaluation between product types through the effects of light.

Gender

Gender is an important factor in decision making such as advertising assessments and product evaluations (Davis & Rigaux, 1974). Many studies have found that men and women use different emotional expressions and information processes. Women have shown more emotional responses than men, and women's emotional expressions have lasted longer (e.g., Allen & Haccoun, 1976; Diener, Sandvik, & Larsen, 1985). Furthermore, men and women

differ in their cognitive processing: men focus on the purpose, not on the relationship, while women place importance on the communication and information processes for the maintenance of relationships (e.g., Cross & Madson, 1997).

Studies have found gender differences in the consumption process (Melnyk, Van Osselaer, & Bijmolt, 2009). Studies have examined the differences between male and female consumers in terms of advertising, products, services, and information sources and have found that male and female consumers differ in their consumption. For instance, female consumers evaluated services by focusing on respect in the relationship, while males assessed services by focusing on the pursuit of a goal or the service itself (Iacobucci & Ostrom, 1993).

Therefore, male and female product evaluations may differ because they follow different information processes and different emotional expressions. This study will examine whether this gender effect influences the interaction between lighting and product type.

Method

Participants

This study's participants comprised 80 undergraduates (40 males, 40 females, with a mean age of 22.18). Four participants had to be excluded because of unwanted responses or too many missing values. A total of 76 participants' data were used for statistical analysis.

Experiment Design

A 2 × 2 × 2 (illuminant level; bright light vs. dimmed light by product type; public vs. private by gender; male vs. female) mixed factorial design was used. Illuminant level and gender were the between-subjects factors, and product type was the within-subjects factor.

Participants were assigned to either a bright light or a dimmed light condition. In the bright light condition, fluorescent lights in the lab were turned on during the experiment (mean 1000 lx). In the dimmed light condition, fluorescent lights were turned off, and the room was dimly lit by light from computer monitors (mean 80 lx). The bright light and dimmed light conditioned were administered alternatively.

Stimuli

We classified product type according to products usage or purchase situations. First, we conducted a pre-test to make a primary product list; these products are known to affect consumers' choices. We selected the products among cars, food, hygienic products, beer, electronics, magazines, furniture, leisure products, and clothes (e.g., Belk, Bahn, & Mayer, 1982). Ten undergraduates answered the question "Please select the products used frequently in

your everyday life." In this primary product list, we excluded products related to gender. Then, 20 undergraduates rated how public or private the products were (1 = public; 9 = private). The product list was then finalized, including the most public products (wall clock : m=2.4, refrigerator : m=3.3, detergent : m=3.3, sofa : m=3.5, telephone : m=3.6) and the most private products (bed : m=6.3, perfume : m=6.7, notebook : m=7.5, watch : m=7.7, cellphone : m=7.9).

Then, stimuli images of the products were presented by 27 inch computer monitor. The background was a gray screen to minimalize the effects of a color background, following previous studies. We inserted blank slides between images to clarify the difference between the target products' image slides.

Psychophysiological Measurement

We used psychophysiological responses to measure the consumers' objective and immediate reactions to the products. The light, an independent variable, produces automatic nervous system responses such as effects on the heart and sweat glands. Thus, we expected that the psychophysiological measurements would more accurately evaluate their responses to the products under the different levels of light. Finally, SCL and HR were used.

Skin conductance reflects electrical conductance resulting from secretions produced by active sweat glands. Skin conductance is often used as a measure of physiological arousal and negative emotional response (Simons, Detenber, Roedema, & Reiss, 1999). Many studies have stated that, when people see large objects or stimuli that are close to them, their skin conductance is accelerated in proportion to the stimulus intensity. Moreover, skin conductance is often used as an index of negative emotional responses: skin conductance may rise when people feel stress.

HR has been interpreted in several ways. Some researchers argue that decreases in HR emerge when people are paying attention or concentrating (e.g., Tremayne & Barry, 2001). Other researchers have found increases in HR when people are excited or under stress. In this study decided to interpret the HR as the index of response according to the stress or excitement.

SCL was expressed in units of microsiemens (μS). We measured general changes in HR (beats per minute: bpm) during the experiment.

Product Attitude

Product attitude was measured using two items and seven-point Likert scale: (1) 'This product is good', (2) 'I like this product' (Mackenzie & Lutz, 1989). The reliability coefficient for scale was Cronbach's α .893.

Purchase Intention

Purchase intention was measured using two items and seven-point Likert scale: (1) "I want to buy this product" and (2) "I will buy this product if necessary" (Engel & Blackwell, 1982). The reliability coefficient for scale was Cronbach's α .802.

Procedure and Data Analysis

When the participants arrived at the lab, they were seated in front of a monitor and were informed about the experiment. After the experiment was explained, three electrodes (one for HR and two for SCL) were attached to the index and middle fingers of the non-dominant hand. When participants had a rest, their baseline was recorded. Each subject participated in three sessions, and 10 different products (five public product and five private product) were used per session. Participants responded to some questions about their environment, such as its illuminance level, and about demographic factors (age and gender). The experiment took about 15 to 20 minutes.

SCLs and HRs were measured using LabChart 7 and were converted into average values for each period. The periods including data noise were excluded, as were data with too many noise periods. All data were analyzed with SPSS 18.0. We conducted an independent t-test as a manipulation check and a three-way mixed ANOVAs to compare the differences among SCLs, HRs, product attitudes, and purchase intentions.

Results

A series of 2 × 2 × 2 mixed analyses of variance (ANOVAs) were conducted with the two-category illuminance level (bright light vs. dimmed light), the two-category gender (male vs. female) variable as a between-subjects factor, and the two-category product type (public vs. private) variable as a within-subjects factor. Separate ANOVAs were conducted for HR change, SCLs, product attitude, and purchase intention.

Manipulation Check

First, we conducted an independent t-test to verify that the manipulation was suitable. Participants were asked to rate how bright the lab environment was; they reported that the room was brighter when the ceiling lights were on (M_{bright} = 6.14, M_{dimmed} = 2.90, $t(74)=14.311$, $p<.000$), implying that our manipulation of ambient brightness was successful.

Moreover, participants reported that the private products were more suitable for private situations than were the public products ($M_{private}$ = 5.23, M_{public} =3.60, $t(150)$

=-15.858, p<.000), implying that our manipulation of product type was conducted appropriately.

SCL

This study measured SCL to assess physiological arousal. A significant main effect of illuminance level (F(1,144)=10.593, p<.01) and product type (F(1,144)=15.352, p<.001) emerged. There was a significant illuminance level - product type interaction (F(1,144)=12.340, p<.01).

Participants under the bright light (M=.836) displayed a higher acceleration in their SCLs than did those under the dimmed light (M=.094). When the presented image was a private product, SCLs accelerated (Mbright = .668, Mdimmed = .058).

SCLs varied according to the illuminance level and product type. When the illuminance level was bright, participants showed a higher skin conductance acceleration for private products (M = 1.265) than for public ones (M = .058). However, there was no differences between product types under the dimmed light (Mprivate = .125, Mpublic = .059).

HR

A significant main effect of illuminance level (F(1,144)=7.456, p<.01) and product type (F(1,144)=24.252, p<.001) emerged. There were a significant illuminance level-product type interactions (F(1,144)=21.254, p<.001), illuminant level-gender interactions (F(1,144)= 4.227, p<.05), and product type - gender interactions (F(1,144)=7.217, p<.01). Moreover, a significant three-way interaction also emerged (F(1,144)=16.401, p<.001).

Table 1. Results of Mixed ANOVA on SCL

Source	SS	df	MS	F
Illuminance level (A)	12.262	1	12.262	10.593**
Product type (B)	15.341	1	15.341	15.352***
Gender (C)	0.536	1	0.536	0.463
A × B	12.331	1	12.331	12.340**
A × C	3.473	1	3.473	3.000
B × C	0.409	1	0.409	0.409
A × B × C	1.286	1	1.286	1.287
Error	155.294	144	2.157	

* p<.05, ** p<.01, *** p<.001

Table 2. Results of Mixed ANOVA on HR

Source	SS	df	MS	F
Illuminance level (A)	30.985	1	30.985	7.456**
Product type (B)	96.349	1	96.349	24.252***
Gender (C)	9.904	1	9.904	2.383
A × B	84.438	1	84.438	21.254***
A × C	17.566	1	17.566	4.227*
B × C	28.672	1	28.672	7.217**
A × B × C	65.157	1	65.157	16.401***
Error	585.265	144	8.129	

* p<.05, ** p<.01, *** p<.001

Participants displayed an accelerated HR under the bright light (M = .143) and a decelerated HR under the dimmed light (M = -.812). When public products were presented, their HRs decelerated (M = -1.166); when participants were shown private products, they accelerated (M = .471).

Moreover, the results showed an interaction between illuminance level and product type. The HRs of the participants under the bright light revealed differences between product types (Mprivate = 1.639, Mpublic = -1.450), but the HRs of the participants under the dimmed light showed no differences between product types (Mprivate = -.759, Mpublic = -.861). There was also an interaction between illuminance level and gender. Under bright light, male and female participants showed variations in HR (Mmale = .691, Mfemale = -.502). Under dimmed light, however, male and female participants showed no such variation (Mmale = -.895, Mfemale = -.725). The changes in HR varied according to product type and gender. For the public products, the males' HRs decelerated more than did the females' (Mmale = -1.335, Mfemale = -.976). For the private products, the males' HRs accelerated more than did the females' (Mmale = 1.131, Mfemale = -.251).

There is a significant three-way interaction. For male participants under the dimmed light, private products (M = -1.065) led to more deceleration than did public products (M = -.725); for male participants under the bright light, public products (M = -1.945) led to more deceleration than did the private products (M = 3.327). For female participants, public products (Mbright = -.955, Mdimmed = -.997) led to more deceleration than did the private products (Mbright = -.048, Mdimmed = -.453) regardless of illuminance level.

Product Attitude

A significant main effect of illuminance level ($F(1, 144)=24.155$, $p<.001$) and product type ($F(1,144)=33.241$, $p<.001$) emerged. There was a significant illuminance level - product type interaction ($F(1,144)=43.466$, $p<.001$). A significant three-way interaction also emerged ($F(1, 144)=5.683$, $p<.05$).

Participants rated the products more positively when under the bright light (Mbright = 4.611, Mdimmed = 4.077) or when the products were private (Mprivate = 4.570, Mpublic = 4.105). Product attitude differed according to illuminance level and product type: under the bright light, participants exhibited positive attitudes to the products regardless of type (Mprivate = 4.579, Mpublic = 4.645), but participants showed better attitudes to the private products than they did to the public products when the products were presented under the dimmed light (Mprivate = 4.568, Mpublic = 3.587).

Concerning product attitude, there was a significant three-way interaction among illuminance level, product type, and gender. Male participants showed higher product attitudes to public products (M = 4.742) than to private ones (M = 4.456) when the products were presented under the bright light. When the products were presented under the dimmed light, however, male participants showed higher product attitudes to the private products (M = 4.637) than to the public ones (3.499). Female participants rated their attitudes to private products (Mbright = 4.702, Mdimmed = 4.498) more positively than they did to public products (Mbright = 4.548, Mdimmed = 3.676) under both illuminance conditions.

Purchase Intention

A significant main effect of illuminance level

Table 3. Results of Mixed ANOVA on Product Attitude

Source	SS	df	MS	F
Illuminance level (A)	10.801	1	10.801	24.155***
Product type (B)	7.917	1	7.917	33.241***
Gender (C)	0.020	1	0.020	0.044
A × B	10.353	1	10.353	43.466***
A × C	0.000	1	0.000	0.001
B × C	0.037	1	0.037	0.155
A × B × C	1.353	1	1.353	5.683*
Error	49.345	144	0.685	

* $p<.05$, ** $p<.01$, *** $p<.001$

Table 4. Results of Mixed ANOVA on Purchase Intention

Source	SS	df	MS	F
Illuminance level (A)	0.187	1	0.187	0.189
Product type (B)	3.258	1	3.258	17.126***
Gender (C)	0.362	1	0.362	0.368
A × B	0.934	1	0.934	4.907*
A × C	0.090	1	0.090	0.091
B × C	0.089	1	0.089	0.467
A × B × C	0.020	1	0.020	0.106
Error	84.674	144	1.176	

* p<.05, ** p<.01, *** p<.001

(F(1,144)=17.126, p<.001) emerged. There was a significant illuminance level - product type interaction (F(1.144)=4.907, p<.05).

Participants showed higher purchase intentions for private products (M = 4.236) than for public ones (M = 3.940).

Purchase intention by product type differed according to the light level. Purchase intention for public products was higher under the bright light (M = 4.054) than under the dimmed light (M = 3.826), while that for private products was higher under the dimmed light (M = 4.277) than under the bright light (M = 4.190).

Discussion

This study was designed to identify the effects of non-conscious factors such as lighting on consumers' emotional responses and cognitive product evaluations by comparing consumers' responses to products through an examination of psychophysiological measurements (SCL, HR), product attitudes, and purchase intentions.

First, consumers' emotional responses differed according to illuminance level: SCL and HR were higher when the product images were seen under the bright light. These results indicate that people felt more aroused and excited under the bright light, as acceleration in SCL is used as an index of psychological arousal, and acceleration in HR is used as an index of excitement (e.g., Simons et al., 1999; Tremayne & Barry, 2001). Thus, bright light makes people feel aroused and excited, supporting the findings of prior studies on light (Smolders & Kort, 2014; Choi et al., 2011).

Moreover, the variations in SCL and HR differed according to illuminance level and

product type: when people were shown public products, no difference between lighting levels emerged; when people were shown the private products, however, differences between lighting levels were obvious. Studies have shown that SCL accelerates under stress or states of tension (Thought Technology, 2004) and that negative situations are more closely related to SCL acceleration than are positive or neutral situations (Bradley, Angelini, & Lee, 2007). Acceleration in HR thus indicates strong stress and emotional arousal (Palomba, Sarlo, Angrilli, Mini, & Stegagno, 2000). Therefore, this study's results suggest that inconsistent conditions lead to negative emotions, which can accelerate psychophysiological responses because a consistent situation or connection leads to positive and stable responses (e.g., Sharma, 2000). Seeing a private product under a bright light is inconsistent because bright light can trigger a more open situation (Steidle & Werth, 2014) while private products are more personal.

However, the public products presented under the dimmed light did not lead to strong psychophysiological responses. Nevertheless, this condition was not a consistent situation either. Thus, we suggest that darkness makes people calm down and relax (e.g., Xu & Labroo, 2014; Choi et al., 2011), explaining the participants' psychophysiological responses to the products.

Furthermore, the variations in HR differed according to illuminance level, product type, and gender. Women experienced decelerated HR regardless of product type, but men exhibited decelerated HR for public products under the bright light and decelerated HR for private products under the dimmed light. These results suggest that emotional responses depend on gender (e.g., Allen & Haccoun, 1976; Diener et al., 1985), confirming that negative emotions can be evoked more readily in men than in women (Codispoti, Surcinelli, & Baldaro, 2008).

The results of this study also show that product attitude and purchase intention differ according to illuminance level and product type as well. Private products triggered high product attitudes, while attitudes to public products were higher under the bright light than under the dimmed light. Moreover, the interaction between illuminance level and product type on product attitude differed according to gender: female consumers preferred the bright light regardless of product type, but males preferred the public products under the dimmed light and preferred the private products under the bright light. This study's findings on product attitude and purchase intention show that people prefer the products that are consistent with the situation evoked by the ambient lighting level, supporting the previous finding that cognitive consistency leads to better consumer responses (e.g., Sharma, 2000). However, the better responses to private products are caused by the effects of involvement: private products are high involvement products (Petty, Cacioppo, & Goldman, 1981); therefore, the product

evaluations are higher for them.

These findings are important for several reasons. First, by suggesting that consumers' emotional responses and cognitive product evaluations differ according to lighting levels and product attributes such as product type, these findings provide the practical implication that consumers prefer lighting that is consistent with product type. Thus, products such as dinner tables, TVs, dishes, and family-centered items should be presented under bright light, while private products such as underwear, sleepwear, and reshaping innerwear should be presented under dimmed light. Moreover, for products presented to male consumers, the environmental lighting should suit the product type because male consumers are more deeply affected by lighting level.

This study has two limitations. First, participants were limited to a certain age group, comprising young students in their twenties. Second, this study did not control for product involvement, which may affect the results. Previous researches have showed product involvement affected product evaluation. Future studies should determine the degree to which lighting level affects the recognition of product values, product image, and the perception of price, while also considering the effects of product involvement.

References

Ahn, H. K., Mazar, N., & Soman, D. (2010). Being hot or being cold: The influence of temperature on judgment and choice. *ACR North American Advances, 37*, 85-88.

Allen, J. G., & Haccoun, D. M. (1976). Sex differences in emotionality: A multidimensional approach. *Human Relations, 29*(8), 711-722.

Areni, C. S., & Kim, D. (1994). The influence of in-store lighting on consumers' examination of merchandise in a wine store. *International journal of research in marketing, 11*(2), 117-125.

Argo, J. J., & White, K. (2012). When do consumers eat more? The role of appearance self-esteem and food packaging cues. *Journal of Marketing, 76*(2), 67-80.

Belk, R. W., Bahn, K. D., & Mayer, R. N. (1982). Developmental recognition of consumption symbolism. *Journal of consumer research, 9*(1), 4-17.

Bradley, S. D., Angelini, J. R., & Lee, S. (2007). Psychophysiological and memory effects of negative political ads: Aversive, arousing, and well remembered. *Journal of Advertising, 36*(4), 115-127.

Browne, B. A., & Kaldenberg, D. O. (1997). Conceptualizing self-monitoring: Links to materialism and product involvement. *Journal of Consumer Marketing, 14*(1), 31-44.

Cajochen, C., Zeitzer, J. M., Czeisler, C. A., & Dijk, D. J. (2000). Dose-response relationship for light intensity and ocular and electroencephalographic correlates of human alertness. *Behavioural brain research, 115*(1),

75-83.

Choi, C. J., Kim, K. S., Kim, C. M., Kim, S. H., & Choi, W. S. (2011). Reactivity of heart rate variability after exposure to colored lights in healthy adults with symptoms of anxiety and depression. *International Journal of Psychophysiology, 79*(2), 83-88.

Codispoti, M., Surcinelli, P., & Baldaro, B. (2008). Watching emotional movies: Affective reactions and gender differences. *International Journal of Psychophysiology, 69*(2), 90-95.

Cross, S. E., & Madson, L. (1997). Models of the self: self-construals and gender. *Psychological bulletin, 122*(1), 5.

Davis, H. L., & Rigaux, B. P. (1974). Perception of marital roles in decision processes. *Journal of consumer Research, 1*(1), 51-62.

Denissen, J. J., Butalid, L., Penke, L., & Van Aken, M. A. (2008). The effects of weather on daily mood: A multilevel approach. *Emotion, 8*(5), 662.

Diener, E., Sandvik, E., & Larsen, R. J. (1985). Age and sex effects for emotional intensity. *Developmental Psychology, 21*(3), 542.

Holbrook, M. B., & Hirschman, E. C. (1982). The experiential aspects of consumption: Consumer fantasies, feelings, and fun. *Journal of consumer research, 9*(2), 132-140.

Hong, J., & Sun, Y. (2011). Warm it up with love: The effect of physical coldness on liking of romance movies. *Journal of Consumer Research, 39*(2), 293-306.

Iacobucci, D., & Ostrom, A. (1993). Gender differences in the impact of core and relational aspects of services on the evaluation of service encounters. *Journal of consumer psychology, 2*(3), 257-286.

Janiszewski, C. (1988). Preconscious processing effects: The independence of attitude formation and conscious thought. *Journal of consumer research, 15*(2), 199-209.

Johar, J. S., & Sirgy, M. J. (1991). Value-expressive versus utilitarian advertising appeals: When and why to use which appeal. *Journal of advertising, 20*(3), 23-33.

Kaida, K., Takahashi, M., & Otsuka, Y. (2007). A short nap and natural bright light exposure improve positive mood status. *Industrial health, 45*(2), 301-308.

Kasof, J. (2002). Indoor lighting preferences and bulimic behavior: An individual differences approach. *Personality and individual differences, 32*(3), 383-400.

Kobayashi, S., Inui, M., & Nakamura, Y. (2001). Preferred illuminance non-uniformity of interior ambient lighting. *Journal of Light & Visual Environment, 25*(2), 2_64-2_75.

Lakoff, G., & Johnson, M. (1999). *Philosophy in the Flesh* (Vol. 4). New york: Basic books.

Lambert, G. W., Reid, C., Kaye, D., Jennings, G. L., & Esler, M. D. (2002). Effect of sunlight and season on serotonin turnover in the brain. *The Lancet, 360*(9348), 1840-1842.

Lansdowne, A. T., & Provost, S. C. (1998). Vitamin D3 enhances mood in healthy subjects during winter. *Psychopharmacology, 135*(4), 319-323.

Lee, S. H. M., Rotman, J. D., & Perkins, A. W. (2014). Embodied cognition and social consumption: Self regulating temperature

through social products and behaviors. *Journal of Consumer Psychology, 24*(2), 234-240.

MacKenzie, S. B., & Lutz, R. J. (1989). An empirical examination of the structural antecedents of attitude toward the ad in an advertising pretesting context. *The Journal of Marketing, 53*(2), 48-65.

Melnyk, V., Van Osselaer, S. M., & Bijmolt, T. H. (2009). Are women more loyal customers than men? Gender differences in loyalty to firms and individual service providers. *Journal of Marketing, 73*(4), 82-96.

Meyers-Levy, J., Zhu, R., & Jiang, L. (2009). Context effects from bodily sensations: Examining bodily sensations induced by flooring and the moderating role of product viewing distance. *Journal of Consumer Research, 37*(1), 1-14.

Milliman, R. E. (1982). Using background music to affect the behavior of supermarket shoppers. *The journal of Marketing,* 86-91.

Palomba, D., Sarlo, M., Angrilli, A., Mini, A., & Stegagno, L. (2000). Cardiac responses associated with affective processing of unpleasant film stimuli. *International Journal of Psychophysiology, 36*(1), 45-57.

Partonen, T., & Lönnqvist, J. (2000). Bright light improves vitality and alleviates distress in healthy people. *Journal of Affective disorders, 57*(1), 55-61.

Petty, R. E., Cacioppo, J. T., & Goldman, R. (1981). Personal involvement as a determinant of argument-based persuasion. *Journal of personality and social psychology, 41*(5), 847.

Sakakibara, S., Honma, H., Kohsaka, M., Fukuda, N., Kawai, I., Kobayashi, R., & Koyama, T. (2000). Autonomic nervous function after evening bright light therapy: spectral analysis of heart rate variability. *Psychiatry and clinical neurosciences, 54*(3), 363-364.

Scheer, F. A., van Doornen, L. J., & Buijs, R. M. (2004). Light and diurnal cycle affect autonomic cardiac balance in human; possible role for the biological clock. *Autonomic Neuroscience: Basic and Clinical, 110*(1), 44-48.

Sharma, A. (2000). Recall of television commercials as a function of viewing context: The impact of program-commercial congruity on commercial messages. *The Journal of general psychology, 127*(4), 383-396.

Simons, R. F., Detenber, B. H., Roedema, T. M., & Reiss, J. E. (1999). Emotion processing in three systems: The medium and the message. *Psychophysiology, 36*(5), 619-627.

Smolders, K. C., & de Kort, Y. A. (2014). Bright light and mental fatigue: effects on alertness, vitality, performance and physiological arousal. *Journal of environmental psychology, 39*, 77-91.

Steidle, A., & Werth, L. (2014). In the spotlight: Brightness increases self-awareness and reflective self-regulation. *Journal of Environmental Psychology, 39*, 40-50.

Steidle, A., Hanke, E. V., & Werth, L. (2013). In the dark we cooperate: The situated nature of procedural embodiment. *Social Cognition, 31*(2), 275-300.

Summers, T. A., & Hebert, P. R. (2001). Shedding some light on store atmospherics: influence of illumination on consumer behavior. *Journal of business research, 54*(2),

145-150.

Thought Technology Ltd. (2004). FlexComp Infiniti Hardware Manual. Montreal: Thought Technology.

Tremayne, P., & Barry, R. J. (2001). Elite pistol shooters: physiological patterning of best vs. worst shots. *International journal of psychophysiology, 41*(1), 19-29.

Warman, V. L., Dijk, D. J., Warman, G. R., Arendt, J., & Skene, D. J. (2003). Phase advancing human circadian rhythms with short wavelength light. *Neuroscience letters, 342*(1-2), 37-40.

Wright, K. P., Hughes, R. J., Kronauer, R. E., Dijk, D. J., & Czeisler, C. A. (2001). Intrinsic near-24-h pacemaker period determines limits of circadian entrainment to a weak synchronizer in humans. *Proceedings of the National Academy of Sciences, 98*(24), 14027-14032.

Xu, A. J., & Labroo, A. A. (2014). Incandescent affect: Turning on the hot emotional system with bright light. *Journal of Consumer Psychology, 24*(2), 207-216.

Zhang, Y., Feick, L., & Price, L. J. (2006). The impact of self-construal on aesthetic preference for angular versus rounded shapes. *Personality and Social Psychology Bulletin, 32*(6), 794-805.

Zhong, C. B., Bohns, V. K., & Gino, F. (2010). Good lamps are the best police: Darkness increases dishonesty and self-interested behavior. *Psychological science, 21*(3), 311-314.

원 고 접 수 일 : 2018. 01. 17.
수정원고접수일 : 2018. 05. 05.
게 재 결 정 일 : 2018. 05. 11.

한국심리학회지: 소비자·광고
Korean Journal of Consumer and Advertising Psychology
2018, Vol. 19, No. 2, 329-347

빛의 밝기와 제품 유형 및 성별이 소비자의 정서적 및 인지적 반응에 미치는 영향: 심리생리학적 측정을 중심으로

손 민 교　　조 미 영　　김 지 호

경북대학교 심리학과

소비자들이 제품을 접하는 환경 내에는 제품뿐만 아니라 빛, 온도, 음악 등 제품과는 직접적인 관련이 없는 다양한 비의식적 환경 요소들이 존재한다. 이러한 요소들은 제품 탐색 및 의사결정과정에 영향을 미칠 수 있다. 따라서 본 연구는 다양한 비의식적 환경 요소 중 빛의 밝기가 소비자의 제품평가과정에 어떠한 영향을 미치는지 확인하고자 하였으며, 나아가 제품 유형과 성별이 평가에 어떠한 영향을 주는지 검증하고자 하였다. 또한, 빛의 밝기와 제품 유형, 성별이 소비자 반응에 미치는 영향을 측정하기 위해 자기보고식 설문뿐만 아니라 피부전도수준과 심박률과 같은 심리생리학적 측정지표를 활용하여 결과의 객관성을 높이고자 하였다. 본 연구에서는 2 (빛의 밝기: 밝음 vs. 어두움) × 2 (제품 유형: 공적 제품 vs. 사적 제품) × 2 (성별: 남성 vs. 여성)의 혼합설계로 실험을 진행하였다. 연구 결과를 종합하면 다음과 같다. 첫째, 빛이 밝을수록 제품에 대해 긍정적으로 평가하는 것으로 나타났다. 이러한 경향은 제품 유형에 의해 조절되는 것으로 나타났는데, 밝은 조명에서 사적 제품을 볼 때 사람들은 높은 정서적 반응을 보였다. 어두운 조명에서 공적 제품을 볼 때 낮은 제품 태도를 보였다. 둘째, 빛의 밝기와 제품 유형 간의 상호작용은 성별에 따라 다르게 나타났는데, 남성이 여성보다 빛의 밝기에 더 많은 영향을 받는 것으로 나타났다. 본 연구는 빛의 밝기에 따른 영향뿐만 아니라 빛의 수준이 제품 유형과 성별에 따라 어떻게 달라지는가를 확인하였다. 또한, 심리생리학적 지표를 이용하여, 각 요인이 의사결정과정에 미치는 영향을 객관적으로 설명하고자 하였다는 점에서 의의가 있다.

주요어 : 빛, 조명 수준, 제품 유형, 성별, 심리생리학적 반응, 제품 평가