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## **Lighting and consumer behavioral intentions in a store environment: the mediating role of perceived stimulation**

### **Abstract**

While previous marketing research emphasizes the positive influence of environmental stimuli on consumers' response, and mentions the stimulating effect of lighting, there is no systematic test and evidence of this effect in controlled settings. This paper explores the influence of two levels of lighting brightness on perceived stimulation and behavioral intentions. Two experimental studies are conducted in a bookstore environment. The results of both experiments show that the perceived stimulation mediates the relationship between lighting brightness and consumer behavioral intentions, that is, purchase intention, number of items planned to purchase and intention to come back.

**Key words:** *Lighting, stimulation, behavioral intentions, store*

**Track:** *Retailing, Channel Management and Logistics*

## Introduction

A great deal of marketing research has studied the influence of store environment conditions on consumers' responses. These studies have generally focused on stimuli, such as music, scent or colors (Crowley, 1993; Spangenberg, Crowley, & Henderson, 1996; Yalch & Spangenberg, 2000) and are based on the environmental psychology (Mehrabian & Russell, 1974) and sensory marketing literature (Bitner, 1992; Daucé & Rieunier, 2002, etc). These stimuli are expected to influence: first, internal responses, such as cognitive, physiological, psychological and affective responses; second, behavioral responses, such as behavioral intentions (intention to buy, or stay) and actual behavior (number of items touched or examined, time spent in store). Surprisingly, little marketing research has been conducted on the effects of lighting conditions on consumers' responses in retail outlet. A few researchers have studied: the effect of display lighting (Areni & Kim, 1994; Summers & Hebert, 2001) on consumers' behavior; the effect of additional lighting in a specific display (Bakini Driss, Ben Lallouna Hafsia, & Zghal, 2008) on shopping behavior; the effect of pleasant or unpleasant lighting, with polysensorial stimuli, on shoppers' affective and behavioral reactions (Lemoine, 2002, 2003). But the influence of in-store lighting on consumers' affective states has not been studied in a controlled environment; therefore, the Mehrabian and Russell's model has never been tested with respect to this lighting stimulus, by isolating its effect. Because models in environmental psychology and in marketing have highlighted the mediation effect of affective states between environmental stimuli and behavioral reactions, we have based our reasoning on the S-O-R Model (Stimulus-Organism-Response: Mehrabian & Russell, 1974). Likewise, we have focused on the Kotler's model (1973), which underlined the role of perceptions. More specifically, it suggests that consumers perceive the "sensory qualities" of the environmental stimuli and that these sensory qualities could influence their buying intentions. In this paper, based on literature in ergonomics, environmental psychology and medicine, we focus on the effect of perceived lighting on the perception of a stimulative environment and on behavioral intentions (i.e., intention to purchase, intention to come back).

### 1. Literature review

#### *1.1. Lighting influence on the stimulative dimension of store perception*

Stimulation is of prominent importance when light illuminance is considered. Research in psychiatry, medicine, clinical psychology, ergonomics has revealed the various effects of light on individuals, and on stimulation in particular.

It has been demonstrated that a cool lighting source has a positive influence on blood pressure (Kobayashi & Sato, 1992) and that light illuminance modulates circadian rhythm (and specifically hormonal cycles); this leads to a succession of stimulating (arousal and activation) and relaxing (relaxed and sleepy) periods (Lam, 1998; Rosenthal, 2005); and lighting brightness has been shown to reduce sleepiness (Nelson, Nillson, & Johnson, 1984). Researchers in clinical psychology and psychiatry suggest that light illuminance stimulates the cardiovascular activity and has a positive effect on physiological arousal (Kumari & Venkatramaiah, 1974), and in turn on psychological arousal (Lewy et al., 1980; Rosenthal et al., 1984; Sher, 2001; Terman, Terman, & Ross, 1998). These effects are particularly significant under very bright lighting conditions and relatively long term exposure.

What effects of lighting brightness can be expected on stimulation under pleasant conditions in a store during a short-term shopping activity?

In ergonomics, on the overall, researchers who are specialized in lighting, measure the impact of lighting on the perception of the environment rather than on affective states (Kruithof, 1941). They consider that this type of measure makes more sense in ergonomics since "*the*

*perceived atmosphere of an environment is expected to be a more stable concept*” (than emotional states) (Vogels, 2008)<sup>1</sup>. And they show that a high intensity of lighting, within comfortable conditions, generates a *liveliness* perception<sup>2</sup> of the environment (Van Erp, 2008).

From all these findings about the stimulating influence of bright lighting, we can expect bright lighting to positively affect the stimulative dimension of store perception, in pleasant conditions.

*H1: A bright cool light has a positive influence on the stimulating perception of the store environment.*

### *1.2. Stimulus-Organism-Response and the mediating role of stimulation*

Based on the M-R (Mehrabian & Russell, 1974), Kotler’s (1973) and Bitner’s models (1992), which suggest that environmental stimuli influence individuals’ affective states and in turn their behavioral reactions, researchers in marketing have partly revealed the mediating role played by internal responses on shopping behavior (e.g. Donovan et al., 1994; Donovan & Rossiter, 1982; Lemoine, 2003; Machleit, Eroglu, & Mantel., 2000; Sherman, Mathur, & Belk-Smith, 1997; Yalch & Spangenberg, 2000), or have shown the positive effect of display lighting or additional lighting on the number of items touched or time spent in store (Areni & Kim, 1994; Bakini Driss, Ben Lallouna Hafsia, & Zghal, 2008; Summers & Hebert, 2001). The mediating role of the stimulating evaluation of the environment between lighting brightness and behavioral intentions in a store environment, in controlled settings, still has to be tested.

*H2: A bright cool light is supposed to have a positive influence on behavioral intentions (intention to buy and intention to come back).*

*H3: Stimulating perception of a store environment mediates the impact of lighting on behavioral intentions (intention to buy, intention to come back).*

In order to test our hypotheses, two experiments are conducted: the first one in a digitally manipulated pictures experiment, the second one in real settings.

## **2. Study 1: A digitally manipulated pictures experiment**

The first study is an exploratory experiment on digitally manipulated pictures in order to simulate two kinds of pleasant lighting; the relevance of visual aids to simulate actual lighting levels and infer different lighting brightness perceptions has already been discussed and shown in previous research (authors, 2010). The lighting conditions are presented below as well as the methodology.

### *2.1. Selection of lighting conditions and pretest*

Light is a form of energy known as electromagnetic radiation that may be perceived by the normal unaided human eyes. Two parameters have to be considered in order to capture the qualities of a lighting source: (1) light illuminance, which describes the intensity of brightness (bright *versus* soft) and (2) Correlated Color Temperature (CCT), which describes the ambiance provided by a lamp (cool *versus* warm). Retail outlets currently attempt to create a pleasant atmosphere, according to the famous Kruithof curve (1941) which characterizes the

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<sup>1</sup> Furthermore, other researchers show no significant effect of lighting brightness on affective states (such as mood in general) under various conditions (e.g., Boray, Gifford, & Rosenblood; 1989; Knez, 2001 ; Veitch, 1997; Veitch & McColl, 2001). Therefore, it makes sense to focus on Stimulation as affective evaluation rather the arousal as affective state.

<sup>2</sup> Four items loaded on this factor: stimulating, motivating, lively and inspired.

two preferred combinations of illuminance level and CCT as “bright cool light and soft warm light”. In order to validate that digitally manipulated lighting condition is realistic, a pretest has been conducted online with a between-subjects design. The sample consisted of 45 respondents (31 women / 14 men). Manipulation of lighting source was perfectly perceived by respondents. The bright cool light was significantly perceived brighter than soft warm light ( $t = 6.177$ ;  $p = .000$ ; MeanBright= 5.43; MeanSoft=2.5).

## 2.2. Experiment, subjects, measures, and results

The sample consisted of 47 French MS in Management students in Paris. 23 students were exposed to soft warm light photographs of a bookstore, and 24 to bright cool light photographs of the same bookstore. Following Spangenberg, Crowley, & Henderson (1996), we measured the perceived environment by items from Fisher’s (1974) scale. We selected three arousal oriented items “Stimulating, Motivating and Lively”<sup>3</sup>, then dropped the item “Lively” in order to enhance the Cronbach’s alpha and the factor’s variance. The behavioral intention was measured by using one 7-point scale: purchase intention.

The aim of this experiment is to test the mediating role of the perception of a stimulating environment between lighting and purchase intentions; we conducted a mediation test with bootstrapped resamples (5000) with Preacher and Hayes’ macro, which is a non parametric resampling procedure. The robustness of this approach is established (Zhao, Lynch, & Chen, 2010) and considered as more relevant than Baron and Kenny’s mediation test.

Table 1- Mediating role of stimulating atmosphere between lighting brightness perception and purchase intention – experiment with digitally manipulated pictures

Independent variable: Purchase intention (N = 47)				
	Coef	Se	t	p
Lighting Brightness on Perceived Stimulation (a path)	.608	.280	2.166	.0356
Perceived Stimulation on Purchase Intention (b path)	.584	.147	3.983	.0003
Lighting Brightness on Purchase Intention (c path)	1.562	.318	4.905	.0000
Mediating effect (c-prime path)	1.207	.290	4.159	.0001
BOOTSTRAP RESULTS FOR INDIRECT EFFECTS			Lower	upper
Bias corrected and accelerated confidence intervals (stimulating environment as mediator)			.028	.789
Level of confidence for confidence intervals: 95; Number of bootstrap resamples: 5000				

We examine the mediating effect of a stimulating atmosphere between lighting perception and purchase intentions. In the indirect path, a unit increase in lighting brightness perception increases the perception of a stimulating atmosphere by a = .61 unit, these results are supportive of hypothesis **H1**. Perception of stimulating atmosphere has a significant effect on purchase intention. The direct effect c (1.562) is also significant ( $p = .000$ ), these findings validate hypothesis **H2**. Results indicate a complementary mediation, supporting hypothesis **H3**. The indirect path of the effects of a lighting brightness perception on purchase intentions through stimulating atmosphere was significant, with the 95% confidence interval excluding zero (.028 to .789).

## 3. Study 2: Lab experiment

The second study aims at increasing the external validity and tests the mediating role of the perceived stimulation between lighting brightness and behavioral intentions in real conditions. The lab experiment was conducted in an office transformed in a mock bookstore (in a French University in Paris). There were various types of bookcases specifically for each type of items (e.g. comics, novels, history, cookery books, management, travel, religion, nature). A table

<sup>3</sup> This items’ selection considered also Vogels’measure (2008) which load three liveliness oriented items (stimulating, exciting, lively). We did not select “exciting”, we have substituted this item by “motivating”.

was arranged in the middle of the store in order to put the best sellers in a prominent place. The white walls were covered with posters and advertisements billboards. The windows of the lab were totally closed; no day light could penetrate in the room.

### 3.1. Selection of lighting conditions and manipulation checks

We selected two kinds of pleasant lighting (Kruithof, 1941) by using fluorescent lamps. The Lighting French Association (AFE) heartily recommends bookstore to set up a lighting brightness of 500 lux with warm light (3000K). We opted for an illuminance of 500 lux and a CCT of 2700K for implementing soft warm light and 600 lux with 6500K for bright cool light. The Color Rendering Index was above 80. Lighting conditions in the lab were similar to the conditions on the digitally manipulated pictures. As for the first study, we were interested in the perceived qualities of lighting (Kotler, 1973; Küller et al., 2006). Accordingly, we have checked that lighting brightness has been well perceived and as expected respondents perceived bright cool light as brighter than soft warm light ( $t=4.57$ ;  $p=.026$ ; MeanBright=4.65; MeanSoft=4).

### 3.2. Experiment, subjects, measures, and results

The sample consisted of 60 French MS in Management students in Paris. This second between-subjects experiment was administered by the same researcher as for the first study. Each respondent was invited to visit the mock bookstore. Lighting brightness was measured by using a Likert 7-point scale of perceived lighting brightness, based on Kotler's suggestion (1973) and on research in ergonomics (Knez, & Enmarker, 1998; Küller et al., 2006) which suggest researchers using perceived lighting rather than actual level to test lighting influence in comfortable situations. The same "arousal oriented" items from Fisher's scale (1974) were selected in order to measure the perception of stimulating environment: stimulating and motivating. The behavioral intentions were measured by using two 7-point scales: purchase intention and intention to come back; and by adding also one 5-point scale: number of items planned to purchase (which makes sense in this realistic shopping situation).

The aim of this study is to examine the mediating role of a stimulating atmosphere between the lighting brightness perception and the behavioral intentions. Because respondents were allowed to look at the different items available in the mock bookstore, we examine the same mediating effect on the number of items planned to purchase and the intention to come back in the retail outlet as well.

Table 2 – Mediating role of stimulating atmosphere between lighting brightness and behavioral intentions in the lab experiment

N = 60	Purchase intention				Number of items planned to purchase				Intention to come back			
	Coef	se	t	P	Coef	se	t	p	Coef	se	t	p
Ligthing Brightness perception on perceived Stimulation (a path)	.219	.110	1.988	.051	.219	.110	1.99	.051	.219	.110	1.988	.051
Perceived Stimulation on Behavioral Intentions (b path)	.829	.241	3.444	.001	0.385	.136	2.820	.007	.756	.214	3.527	.001
Lighting Brightness perception on Behavioral Intentions (c path)	.415	.318	.212	.064	.308	.121	2.543	.014	.431	.196	2.193	.032
Mediating effect (c-prime path)	.233	.290	.208	.2674	.2236	.118	1.892	.063	.265	.186	1.431	.158
Bootstrap results for indirect effects			lower	upper			lower	upper			lower	upper
Bias corrected and accelerated confidence intervals (stimulating environment as mediator)			.012	.427			.003	.233			.008	.395
Level of Confidence for Confidence Intervals: 95, Number of bootstrap resamples: 5000												

We examine the mediating effect of a stimulating atmosphere between lighting brightness perception and purchase intentions. Analyses have been conducted through Preacher and Hayes's macro with bootstrapped resamples (5000). A bright lighting increases the perception of a stimulating atmosphere by  $a = .22$  unit ( $p = .051$ ), this result validates hypothesis **H1**. Preacher and Hayes enable us to test a mediating effect without a significant effect  $c$ , results indicate an indirect mediation only, with the 95% confidence interval excluding zero (.012 to .427) (Zhao, Lynch, & Chen, 2010), supporting hypothesis **H3** in real conditions but rejecting hypothesis **H2**. Considering the mediation on the number of items planned to purchase and the intention to come back, the Preacher and Hayes' macro with a bootstrapped sample (5000) indicates a complementary mediation, with the 95% confidence interval excluding zero (.003 to .233) (Zhao, Lynch, & Chen, 2010). Hypotheses **H1**, **H2** and **H3** are validated.

## Discussion and further research

Results in both experiments show the mediating role of the perceived stimulation between lighting brightness and behavioral intentions. Study 1 also highlights the relevance of a visual experiment on digitally manipulated pictures in order to study the perception of a lighting source; this responds to previous research that casts doubt on the ability of visual method to simulate environmental stimuli (Eroglu & Machleit, 1990). Further research is needed, however, in order to test multisensory stimuli (for example lighting and temperature) of retail outlets on consumer's internal and behavioral reactions, under controlled conditions.

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