STRATEGIC MANAGEMENT, Vol. 27 (2022), No. 4, pp. 041-054

DOI: 10.5937/StraMan2200014T

Received: Nov 21, 2021
Accepted: Feb 06, 2022
Published online: May 13, 2022

The influence of retail facility lighting on shoppers' product perception

Dejan Tešić
University of East Sarajevo, Faculty of Economics Brčko, Brčko, Bosnia and Herzegovina
https://orcid.org/0000-0002-4256-4416
Zoran Bogetić
University of Belgrade, Faculty of Economics, Belgrade, Serbia
https://orcid.org/0000-0001-7513-2903
Goran Petković
University of Belgrade, Faculty of Economics, Belgrade, Serbia
https://orcid.org/0000-0001-7304-9751

Abstract
Background: The subject of the paper is lighting, which represents one of the instruments of shopper marketing. Review of the relevant literature suggests that lighting can have a significant impact on the appearance of the observed product.
Purpose: The aim of this paper is to evaluate whether lighting in a retail facility affects the behaviour of shoppers on the Serbian market.
Study design/methodology/approach: Data for testing hypotheses were collected from the sample on the market of Serbia. In order to collect data, an online experiment was conducted. Data were processed using repeated measures one-factor analysis of variance.
Findings/conclusions: Based on the research results the conclusion is that different treatments of lighting colour and temperature affect the shoppers' perception of the quality of the observed product, but do not affect shoppers' price perception of the observed product on the Serbian market.
Limitations/future research: Limitations of this research are: research on the basis of one characteristics of lighting, online research, one subject of observation, number of treatments, light source and influence of the device screen characteristics. Future research should include: research in more realistic conditions, usage of various stimulus and sources of artificial lighting and identification of the device by which the respondent accessed the questionnaire with the aim of comparison of the obtained results.

Keywords
lighting, lighting colour temperature, quality perception, price perception, retail

Introduction

In the context of a retail facility, the term "atmosphere" was first introduced by Kotler (1973), who stated that conscious planning of the atmosphere in a retail facility could contribute to a shopper's propensity to purchase. Designing the desired atmosphere is achieved by a combination of factors that represent the variables of the atmosphere. According to Turley and Milliman (2000), there are as many as 43 purchase triggers within a retail facility, which have the potential to influence shopper evaluation and behaviour. The adaptation of the atmosphere to the type of shoppers that visit retail premises is crucial for the potential increase in the number of visits to the facility in question, as well as for the influencing the amount of time spent within the facility, which can ultimately affect the shoppers' desire to view and feel products (Hyllegard, Ogle & Dunbar, 2006), and increase the number and amount of purchases (Turley & Chebat, 2002). Regarding the aforementioned goals, atmosphere in a retail facility could be seen as a part of shopper marketing (Petković & Bogetić, 2014; Bogetić & Petković, 2015).

One of the most significant atmosphere variables is lighting. In an effort to create practical, very often "theatrical" experience, many of the world's leading retailers pay close attention to this factor, understanding its potential to change shoppers' perception (Hyllegard, et al., 2006). The first research on the importance of the role of lighting in retail was focussed on the functional and technical characteristics of lighting, such as glare and flicker of light. During the 1960s and 1970s, researchers began shifting their focus to the impact of retail facility lighting on the feelings of individuals, i.e. shoppers (Murdoch & Caughey, 2004). A significant number of studies on the psychological effects of lighting in retail appeared in the 90s (Knez, 1995). The reason for such a development in understanding of the impact of lighting on an individual's emotional response lies in the fact that, until the 1970s, stores mostly relied on daylight as the dominant source of illumination. The 1970s and the beginning of a revolution in energy consumption in retail facilities caused the situation where approximately 70% of total energy consumption went to the creation of artificial lighting (Henderson-Smith, 2003). Daylight, as a source of illumination, became obsolete because of its inability to cover large enclosed areas where light does not reach distant parts of the facility. In addition to this, it largely depends on atmospheric conditions (sunshine, clouds, rain, etc.).

Certain characteristics of lighting, such as brightness and colour temperature, change shopper behaviour and increase or decrease retailer's revenue. For example, a "cooler" colour temperature of lighting affects shopper's longer stay in a retail facility and, potentially, a higher amount of purchased goods (Barlı, Aktan, Bilgili & Dane, 2012). With the development of technology, an increasing body of research in the field of the impact of lighting on retail shopper behaviour is being conducted in the laboratory instead of retail facilities (Park & Farr, 2007). Laboratory conditions allow researchers to distinguish the influence of lighting from other factors that make up the overall atmosphere (music, crowds, smells, etc.), which is practically impossible in terms of observing shopper behaviour in real retail facilities (Reddy, Reddy & Azeem, 2011).

Lighting in a retail facility is influenced by many factors, and the task of the retailer is to find the right combination of its characteristics in order to achieve optimal lighting for the interior of a particular retail facility (Custers, De Kort, Ijsselsteijn & De Kruiff, 2010).

When creating a lighting strategy in a retail facility, the retailer should pay attention to three key lighting characteristics (Hartnett, 1995):

- illumination;
- lighting colour temperature;
- colour rendering index.

Brightness is a characteristic of lighting that stems from the visual impression that an illuminated object emits more or less light. The brightness level varies depending on the colour of the observed object. Lighter shades of the same colour create the impression of a higher level of brightness than darker shades. In addition to this, under the same lighting conditions, some colours create the impression of a higher level of illumination. On the colour scale, under the same lighting conditions, white objects give the impression of the highest level of illumination, while black objects do the opposite. However, we should bear in mind that the level of illumination is a subjective category that varies from individual to individual. A higher level of illumination causes shoppers to take a larger number of products into consideration, and consequently stimulates the purchase of products (Reynolds-McIlnay, Morrin & Nordfal, 2017).

Artificial light sources emit lighting that consists of different combinations of wavelengths, which means that the manipulation of those wavelengths can affect the colour of the lighting perceived by the observer. The colour of the light emitted by an artificial light source is characterized by the Correlated Colour Temperature (CCT). The colour temperature of illumination is expressed in Kelvin. When we encompass all light sources, both natural and artificial, the temperature range of lighting colour ranges from 1700K (lighted candle) to approximately 6500K (daylight). According to Lechner (2009), individuals perceive light colour temperatures below 3,000 Kelvin as warm, and over 5,000 Kelvin as cold.

The Colour Rendering Index (CRI) refers to the characteristic of illumination that represents the ability of an artificial light source to display the colour of an illuminated object in the most faithful way, compared to the reference light source with the same light colour temperature. In other words, the colour rendering index shows how natural the colour of an object illuminated by

an artificial light source looks. The Colour Rendering Index is expressed on a scale from 0 to 100. Light sources that have CRI greater than 80 are considered to have excellent colour rendering. CRI below 60 is considered poor (Davis & Ohno, 2005).

Retailers usually have very little time to make contact with shoppers, and to present the products displayed on the shelves of a retail facility in a proper way (Mari & Poggesi, 2013). Therefore, in addition to the aforementioned influence of lighting on the mood, i.e. emotional response of the shopper indoors, it is important to explore the impact of lighting on the perception of the products that are subject to observation, that is, on the evaluation conducted by the shopper. Product perception refers to the perception of the aesthetic, symbolic and functional value of a product, as well as the perception of product's quality (Creusen, 2010). Aesthetic and symbolic values of products represent expressive aspects of products, while functional values and perception of quality represent utilitarian values. The expressive aspects of product are perceived by the shopper holistically, which means that the shopper's perception of aesthetic and symbolic values is based on the global impression of that product. The perception of product's utilitarian values is conducted based on evaluation of details and characteristics of products. Nevertheless, although the perception of product quality, resides in the domain of the utilitarian aspect of the product, it is based on a holistic evaluation of that product, and in that case, lighting can play a very important role. While in a retail facility, shopper often does not have time to perform a detailed analysis of product, and it is then and there that appropriate lighting, which corresponds to a holistic product evaluation, can determine the perception of product quality (Oh, Janiszewski, Baek, Choo & Yoon, 2016).

The following theoretical and empirical conclusions are based on data collected during work on the doctoral dissertation of the first author of this paper.

1. Literature review

The following section of this research brings concise presentation of relevant papers from acclaimed journals, in which the authors investigate the impact of lighting on shopper behaviour.

According to the conclusions of the research presented below, as part of the atmosphere in a retail facility, lighting can affect the shoppers' perception of certain characteristics of a retailer, as well as its behaviour during the shopping. Moreover, the lighting of product can affect the perception of its characteristics, such as quality perception, price perception, intention to buy, etc.

Areni and Kim (1994) investigate the impact of lighting on merchandising activities in a retail facility specialized in the sale of wine. The research was conducted in a restaurant with a wine cellar that visitors can visit, taste wine and make a purchase in it. Based on the collected data, the authors concluded that stronger lighting affected shoppers in the way that they pay more attention to the goods, especially those that are arranged at eye level. The changes in lighting do not impact the time spent in the retail facility, nor the change in the amount of goods sold.

Deepika and Neeraja (2014) investigated the impact of lighting on shopper behaviour in retail outlets specialized in clothing sales. In order to collect data, the authors conducted field research in 10 retail facilities, after which the authors concluded that lighting conditions in the retail facility do not greatly affect planned and unplanned purchase, or total time spent in the retail facility and the amount of money spent on purchases by the respondents. However, one of the conclusions of this research was that stronger lighting could be a factor that attracts shoppers to spend more time in a retail facility, which may prove to be a prerequisite for the increased amount of money spent on purchases.

Park and Farr (2007) investigated the impact of lighting on the emotional state and behaviour of shoppers in a retail environment. The experiment was conducted in the laboratory and their research had a cross-cultural quality. The test area was specially designed in order to minimize all environmental influences that could potentially infest the isolated observation of lighting and its influence as a stimulus capable of affecting shopper behaviour. By comparing two cultures of classified respondents, the authors came to the following conclusions: for both groups of subjects, light colour temperature of 5000 Kelvin caused a higher state of excitement than the second modality, when colour temperature was 3000 Kelvin. The respondents perceived colour temperature of lighting as warm in the case of the modality with a colour temperature of 3000 Kelvin, while colour temperature model of 5000 Kelvin was qualified as cold. In addition to this, both groups of the respondents claimed that the

3000 Kelvin light colour temperature modality created a greater sense of satisfaction, compared to the other modality. In the end, the authors concluded that shoppers generally prefer warm colour temperatures of lighting.

Quartier, Vanrie and Van Cleempoel (2014) focused their research on the phenomenon of lighting in a retail facility and its impacts on the perception of the atmosphere, emotions, and shopping behaviour. For the purpose of data collection, the authors designed an experiment based on the simulation of a retail facility in laboratory conditions. After the analysis of the obtained results, the authors concluded that there was no significant difference in the degree of the perception of the atmosphere, except for the dimension of liveliness. The difference was noticeable in the lighting setting that was characteristic for a retailer considered as a highly regarded retail brand, compared to the other two settings, which related to a medium-ranked and low-ranked retailer brands. In addition, the authors concluded that there was no statistically significant difference in the perception of quality, price and service, total duration of purchase time, the amount of purchased products and money spent on product purchase.

Barli et al. (2012) investigated the impact of lighting and interior colour on shopper behaviour and time spent in a retail facility. For the purposes of data collection, the authors conducted field research covering four categories of products sold in the retail facility: underwear, clothing, shoes and jewellery. Based on the processed data and obtained results, the authors concluded that the green colour of the interior walls and the time spent in the retail facility affect the purchase. The low-light mode had a positive effect on the time spent in the retail facility. The red colour of the interior walls negatively affected the time spent in the facility. The authors further concluded that poorer lighting affected purchases and the time shoppers spent in a retail facility.

Lin and Yoon (2015) investigated the impact of lighting on shopper behaviour in retail sale. The authors argued that lighting has the potential to attract shoppers, to arouse their interest in evaluation and later, in the purchase of products as well. A special focus of their paper was placed on the contrast and colour temperature of lighting as a characteristic of lighting, and their impact on shopper behaviour in the retail facility. For the purposes of data collection, the authors created and conducted an experiment in laboratory conditions. After analysing the results of empirical research, the authors came to the following conclusions: lighting in high contrast conditions attracts the attention of the respondents more, compared to lighting in high contrast conditions. In addition, the attention of the respondents is at a higher level in conditions when the lighting has a cold temperature of the lighting colour, in contrast to the setting with the warm lighting colour temperature.

Briand and Pras (2010) focused their research on the impact of lighting and temperature perception on the evaluation of the degree of the attractiveness of a retail facility. For the purposes of data collection, the authors devised an experiment aimed at creating the desired conditions of lighting modality and temperature. The results of the research indicated the following conclusions: strong lighting with a "cooler" temperature colour affects the degree of the stimulation factor in the retail facility. Poor lighting with a warm colour temperature affects the positioning degree. The respondents associate this lighting modality with retail facilities that belong to the "upper class". Regarding the relaxation factor, there is no significant statistical difference in the perception of the factor degree. Also, the authors conclude that there is a connection between the modality of lighting and the type of retail facility. Strong lighting with a "cooler" temperature of the lighting colour enhances the degree of stimulation in retail outlets specializing in the sale of books and retail stores specialized in furniture sale.

The focus of the work of the authors Tantanatewin and Inkarojrit (2016) was placed on the effects that lighting and colours have on the impression of shoppers regarding the retail facility, as well as on the brand image of the retailer. For the purposes of data collection, the authors created an experiment in which the respondents evaluated the perception of given attributes by observing images of a retail facility. Based on the collected data and the results obtained, the authors concluded the following: the perception of the retail space is influenced by the colour of the interior walls. The respondents rated coloured areas more positively than the space without colour (white colour). Regarding the lighting colour temperature, the respondents rated the interior of the retail facility illuminated with a warm colour temperature lighting modality with higher grades, compared to the modality with a cold colour temperature. In the case of

illumination of the room with the modality of warm lighting colour temperature, the respondents rated the space as expressive and exclusive, while the space illuminated with cold lighting colour temperature was perceived as "technical", lacking in the field of intimacy.

Biswas, Szocs, Chacko and Wansink (2017) focused their research on the influence of lighting in the field of food products category. To order to achieve the results of the research, the authors conducted five experiments. Based on the obtained results, the authors concluded that the respondents prefer "unhealthy" products in the conditions of poorer lighting. The results of the first experiment suggested that the respondents prefer to consume high-calorie products when the lighting is dimmer. The result of the second experiment showed that the respondents' awareness of healthy eating habits was at a higher level when the lighting was stronger or at a lower level when the lighting was poorer. The conclusion based on the results of the third experiment was that, despite the fact that the respondents had to choose the products aloud; there was no deviation from the results of the second experiment, although something like that was expected to happen. The fourth experiment proved that raising awareness regarding the consumption of "healthy" or "unhealthy" food led to an increased tendency toward "healthy" options, even in poor light conditions, and the same conclusion was reached by analysing the results of the fifth experiment, when the respondents were warned in advance to take care of healthy eating habits.

Horska and Bercik (2014) focused their research on the impact of lighting on the behaviour of food product shoppers. In order to establish the connection between lighting and shopper preferences, the authors conducted a research in which they used neuromarketing tools along with a questionnaire. Based on the results of the research, the authors concluded that lighting has an impact on the conscious and subconscious reactions of the shopper. The results of using an electroencephalograph indicated the fact that, when the lighting changes, the right hemisphere of the brain is more involved, which is associated with an emotional response. The largest number of subconscious reactions was registered when the subjects were exposed to lighting created by fluorescent light bulb. The greatest emotional reaction of the respondents was caused by the lighting source of a metal halide light bulb, while the respondents rated the lighting created by the halogen light bulb as the most attractive one. The least attractive lighting, according to the respondents, was the one of metal halide bulbs and LED bulbs.

Nagyova, Bercik and Horska (2014) focused on the efficiency, intensity and impact of directional lighting on shopper reactions in retail stores specialized in the field of groceries. The strongest emotional response of the respondents came as a consequence of observing the product with illuminated lighting modalities, whose source was a halogen and metal halide bulb with the colour temperature of the 2700 Kelvin and 3000 Kelvin, respectively. The smallest impact on the emotional response of the respondents occurred as a result of observing the product with illuminated lighting modalities whose source was an LED and metal halide bulb, the colour temperature of illumination of 5600 Kelvin and 5000 Kelvin, respectively. This meant that warm colour temperatures caused stronger emotional responses, compared to cold colour temperatures. Based on the data gathered in the questionnaire, the authors concluded that respondents identify as the most attractive lighting modality one that was caused by the radiation of a halogen bulb with a colour temperature of 2700 Kelvin. However, it was concluded that this lighting modality was the most uneconomical, both from the point of the initial investment and electricity consumption and the rate of necessary replacement of the bulb, due to the limited working hours. At the same time, the authors noticed that a higher degree of emotional response was present in female respondents, compared to respondents who were male.

Yang, Cho and Seo (2016) investigated the impact of lighting on the acceptability and shopper's desire for product consumption. The aim of the research was to establish whether there was a connection between the lighting environment and the perceptions of the characteristics of the observed products belonging to the food category (apples and peppers). The results of the research led to the following conclusions: there was a statistically significant difference in the degree of readiness for consumption of the observed products according to the lighting modality of illumination. The readiness to consume apples was the highest in the case of the yellow lighting modality, while it was lowest with blue lighting modality. In the case of the product number two (peppers), the

respondents reported that they were more willing to consume peppers illuminated with white or yellow colour than vegetables illuminated with modalities related to green, blue, or red. By observing the likeability of these two products, the influence of the lighting modality on the differences in the assessment was also noticed. Greater liking of both apples and peppers was noticed when the products were illuminated with yellow and white lighting modalities, compared to the other three lighting modalities.

Otterbring, Lofgren and Lestelius (2014) conducted an exploratory study to determine whether lighting affects the evaluation of packaged food products. The research was conducted in laboratory conditions. Based on the obtained results, the authors concluded that the age of the respondents and the colour of product packaging did not affect the evaluation of the mentioned dependent variables, while the colour temperature of lighting had a statistically significant influence on the evaluation of the observed variables. The respondents rated with statistically significantly higher grades perceptions of quality, attractiveness and taste of the products illuminated by lighting modality with a warm colour temperature, compared to the products illuminated by lighting modality with a cold colour temperature. In addition, they came to the conclusion that there was no statistically significant difference in the assessment of price perception, regardless of the lighting modality of the products observed.

Han and Suk (2019) investigated the influence of lighting and colour on the emotional response of shoppers. The subject of research was a product from the category of household appliances (electric stove). After collecting data and analysing the results, the authors concluded that the respondents preferred a light colour temperature of 3500 Kelvin. Food lit by a light emitting source of the aforementioned lighting temperature looked delicious. Nevertheless, the respondents estimated that the modality of lighting with a colour temperature of 5000 Kelvin contributed to making food look fresh. After conducting the first part of the research, the authors conducted the second part of the research, where they used the method of experiment. Based on the results of the research, the authors concluded that the respondents preferred ovens in which the light source emitted lighting with a cold lighting temperature (5000 Kelvin) compared to the modality with a warm light colour temperature (3000 Kelvin). This finding was the opposite of their expectation because, according to a review of the literature, people generally prefer warm to a "cold lighting colour temperatures."

Zielke and Schielke (2016) focused their work on the impact of lighting on shopper perceptions within the retail facility, as well as on their shopping behaviour. The aim of the author's endeavours was to establish how lighting affects shopper perception regarding the atmosphere, quality and price perceptions, and purchase intentions in the observed retail facility. To collect data, the authors designed and conducted two experiments. The results of the research, based on which the first experiment was conducted, indicated the following conclusions: a higher degree of intensity and emphasis of lighting affected a higher degree of satisfaction of the respondents, but not the perception of price. In the case of quality perception, the results of the research indicated the conclusion that the intensity of lighting did not affect the perception of quality, as well as the greater intention to buy products in the observed retail facility. The results of the second experiment suggested the following conclusions: by analysing the results of the influence of the lighting colour on the already states dependent variables, it was concluded that the warm temperature of the lighting colour affected a higher degree of satisfaction of the respondents. There was no statistically significant difference in the mean values of price perception, observed by the modalities of the colour temperature of lighting. In the case of the dependent variables related to the perception of quality and intention to buy, the conclusion was that the respondents gave a higher assessment of quality and expressed a higher degree of intention to buy in the case of lighting modality with a warm colour temperature, compared to lighting modality with a "cooler" colour temperature of lighting.

Yilmaz (2018) investigated the impact of lighting on shoppers' perceptions in a retail facility. The aim of the author's work was to establish the influence of lighting on the perception of the interior of a retail facility, as well as the perception of quality and price of products. To collect data, the author devised an experiment. Based on the data processing, the author concluded the following: when observing the influence of the lighting modalities on the perception of the entire interior of the retail

facility, the respondents gave the highest positive grades in the situation when the lighting modality was presented in such a way that only directed lighting is used. In the case of the perception of products, it was also found that lighting design affects this variable. The expectation of the highest price was expressed in the situation when the respondents observed the modality with exclusively directed lighting, while the price was perceived as low in the case of observing the display of a retail facility whose interior is illuminated by the usual lighting modality. Regarding the perception of quality of products located in a retail facility, the authors concluded that the perception of quality grows along with the change of lighting design, from the first modality with the usual design to the third modality with the design of exclusively directed lighting.

Based on a review of relevant literature, this paper seeks to answer the research question regarding whether the colour temperature of lighting, as one of the characteristics of lighting, affects the behaviour of shoppers in terms of their perception of quality and price perception of the observed product.

In order to answer this question, the following hypotheses were defined, and tested on the Serbian market:

- Colour temperature of lighting affects the shopper's perception of product quality;
- Colour temperature of lighting affects the shopper's perception of product's price

2. Methodology

The review of relevant literature that covered various issues in the field of examination of the impact of lighting on shopper behaviour in retail was used to create a specific research design; this framework is presented in Table 1.

Table 1 Research design

Research approach	Quantitative research
Method of data collection	Online experiment
Sample	Serbian market
Sample size	200 respondents
Subject of observation (product)	The products that are the subject of observation in the photo treatments are apples, photographed in a fruit display case typical for retail facilities in the surrounding area.
Dependent variables	Perception of product quality; and Product price perception
Independent variable	Colour temperature of lighting - 6 treatments.
Statistical methods used for data processing	Descriptive statistical methods: Arithmetic mean and standard deviation. Methods of statistical inference: One-factor analysis of the variance of repeated measurements.

Source: the authors' calculation

Specifically, in the case of research conducted for data collection purposes in this paper, an online panel was used. Online panels are one of the online sampling techniques, characterized by fast and flexible access to the sample plan. The main feature of the online sample panel is the high response rate of the respondents.

In order to achieve the greatest possible representativeness of the samples for the observed market of Serbia, used in the process of conducting an empirical research, the services of a professional market research agency were used.

Data collection in the target markets was performed using the CAWI (Computer Assisted Web Interviewing) technique, by conducting an online survey. The target group of respondents consisted of people who make decisions and buy groceries for the needs of the household – alone or with another member of the household. The created sample was nationally representative in terms of gender, age categories and regions of the targeted markets, all according to the latest censuses or population estimates.

At the very beginning of recruiting, the respondents answered two eliminatory questions, and only those who answered negatively to both questions, took part in the research. These two eliminatory questions relate to this:

- Are the respondents professionals in the field of lighting or in the field of indoor interior design? and
- Do the respondents have physical difficulties in distinguishing colours?

With the aforementioned questions, the influences of the respondents' answers that may impair the relevance and objectivity of the research were neutralized.

The respondents who participated in the survey answered questions from a two-part questionnaire.

In the first part, the respondents were asked to answer questions regarding demographic characteristics.

In the second part, the respondents had the task to evaluate photograph treatments of the product, which differ only in the temperature of the light colour used while taking photographs.

Table 2 Experiment design

Respondents (experimental units)	Treatment (level of independent variable) - lighting treatments by light colour temperature expressed in Kelvin (K)					
	Treatment 1 (2200K)	Treatment 2 (2700K)	Treatment 3 (3000K)	Treatment 4 (4230K)	Treatment 5 (5400K)	Treatment 6 (6500K)
Respondent 1	Effect of treatment 1 on subject 1	Effect of treatment 2 on subject 1	Effect of treatment 3 on subject 1	Effect of treatment 4 on subject 1	Effect of treatment 5 on subject 1	Effect of treatment 6 on subject 1
Respondent 2	Effect of treatment 1 on subject 2	Effect of treatment 2 on subject 2	Effect of treatment 3 on subject 2	Effect of treatment 4 on subject 2	Effect of treatment 5 on subject 2	Effect of treatment 6 on subject 2
Respondent 3	Effect of treatment 1 on subject 3	Effect of treatment 2 on subject 3	Effect of treatment 3 on subject 3	Effect of treatment 4 on subject 3	Effect of treatment 5 on subject 3	Effect of treatment 6 on subject 3
Respondent n	Effect of treatment 1 on subject n	Effect of treatment 2 on subject n	Effect of treatment 3 on subject n	Effect of treatment 4 on subject n	Effect of treatment 5 on subject n	Effect of treatment 6 on subject n

Source: the authors' calculation

The research was designed in the form of an experiment (Table 2), where each respondent (experimental unit) was required to evaluate all three dependent variables, i.e. effects (quality of perception and price perception sequentially in relation to six treatments of photographs created through the impact of independent variable "colour temperature of lighting".

3. Results

For the purposes of testing research hypotheses on the Serbian market, a sample, whose characteristics are shown in Table 3, was created.

Table 3 Sample characteristics

Demographic characteristics of respondents	Sum	Percentage
Gender		
• male	100	50,0%
• female	100	50,0%
The market region in which the respondent lives		
• Belgrade	51	25,5%
• Vojvodina	56	28,0%
• Šumadija and Western Serbia	52	26,0%
• Southern and Eastern Serbia	41	20,5%
The type of settlement in which the respondent lives		
• city	129	64,5%
• village	71	35,5%

Source: the authors' calculation

By analysing the data from Table 3 it can be concluded that, according to the gender of the respondents, we have an equal distribution of male (n = 100) and female (n = 100) respondents. As for the region of the Serbian market in which the respondents live, the largest number of respondents live in Vojvodina (n = 56), followed by Šumadija and Western Serbia (n = 52), Belgrade (n = 51) and, finally, Southern and Eastern Serbia (n = 41). According to the type of settlement in which the respondent lives, a larger number of respondents live cities (n = 129), compared to villages (n = 71).

Descriptive statistical methods are used to process and display data, along with the use of tables, graphs and summary measures. Based on the use of descriptive statistical methods, with the aim of analysing data collected from 200 respondents, the values of the arithmetic mean and standard deviation were obtained (Table 4).

Table 4 Descriptive statistics

	Treatment of 2200 Kelvin		
	Number of respondents	**Arithmetic mean**	**Standard deviation**
Perception of quality	200	4,41	1,491
Price perception	200	4,21	1,175
	Treatment of 2700 Kelvin		
	Number of respondents	**Arithmetic mean**	**Standard deviation**
Perception of quality	200	4,57	1,561
Price perception	200	4,36	1,111
	Treatment of 3000 Kelvin		
	Number of respondents	**Arithmetic mean**	**Standard deviation**
Perception of quality	200	4,81	1,380
Price perception	200	4,38	1,068
	Treatment of 4230 Kelvin		
	Number of respondents	**Arithmetic mean**	**Standard deviation**
Perception of quality	200	5,00	1,569
Price perception	200	4,49	1,199
	Treatment of 5400 Kelvin		
	Number of respondents	**Arithmetic mean**	**Standard deviation**
Perception of quality	200	4,81	1,575
Price perception	200	4,37	1,216
	Treatment of 6500 Kelvin		
	Number of respondents	**Arithmetic mean**	**Standard deviation**
Perception of quality	200	4,48	1,748
Price perception	200	4,39	1,420

Source: the authors' calculation

Based on the data from Table 12, we can conclude the following: in relation to the dependent variable "quality perception", the highest value of the arithmetic mean (5.00) is characteristic for the treatment of light colour temperature of 4230 Kelvin, while the lowest value of the arithmetic mean (4.41) of the same variable is characteristic for the treatment of 2200 Kelvin. In the case of the dependent variable

"price perception", the highest value of the arithmetic mean (4.49) is characteristic for the treatment of 4230 Kelvin, and the lowest value of the arithmetic mean (4.21) of the same variable is characteristic for the treatment of 2200 Kelvin. Based on the presented data, we can conclude that the highest values of means for both dependent variables are characteristic for the treatment of light colour temperature of 4230 Kelvin, while the lowest values of arithmetic means of the same dependent variables are characteristic for the treatment of 2200 Kelvin.

3.1 First hypothesis: The colour temperature of the lighting affects the shoppers' perception of product quality.

In order to test the first hypothesis, the statistical technique of one-factor repeated measures analysis of variance was used. Prior to the analysis, the successful application of this statistical technique required testing of the assumptions.

The data type satisfied the condition for the application of one-factor repeated measures analysis of variance because the independent variable was categorical and expressed on a nominal scale, while the dependent variable was quantitative and was expressed on an interval scale (7-point Likert scale).

The respondents were examined independently of each other, so it can be concluded that the assumption of the independence of the observation was fulfilled.

The Shapiro-Wilk test was used for the confirmation of the assumption of normality, and the results can be seen in Table 5.

Table 5 Verification of the assumption of normality

	Value	df	p-value
Perception of quality 2200K	0,910	200	0,000
Perception of quality 2700K	0,922	200	0,000
Perception of quality 3000K	0,909	200	0,000
Perception of quality 4230K	0,902	200	0,000
Perception of quality 5400K	0,914	200	0,000
Perception of quality 6500K	0,917	200	0,000

Source: the authors' calculation

Based on the results from Table 5, we can see that the p-values of the Shapiro-Wilk test for all effects are lower than the significance level $\alpha = 0.05$, so it can be concluded that, with an error risk of 5%, we reject the null hypothesis of normal distribution of observed effects.

Nevertheless, the statistical technique of one-factor repeated measures analysis of variance is robust for large samples ($n = 200 > 30$), so the verification of the sphericity assumption was continued.

Table 6 Verification of the assumption of sphericity

	Mauchly W	χ^2 value	df	P-value	Epsilon		
					Greenhouse-Geisser	Huynh-Feldt	Lower bound
Quality perception	0,496	138,283	14	0,000	0,755	0,771	0,200

Source: the authors' calculation

According to the results of the Mauchly test (Table 6), we conclude that, with 5%, risk of error, we reject the null hypothesis of data sphericity ($\chi 2 = 138.28$; $p = 0.000$).

Based on the rejection of the null hypothesis of sphericity, two options become available, and they relate to the application of the Greenhouse-Geisser or Huynh-Feldt correction.

Guided by the "rule of thumb", when choosing one of the two types of these corrections, regarding the fact that the value was $\varepsilon = 0.755 > 0.75$, the Huynh-Feldt correction was chosen to check the statistical significance of the F-value. After applying the Huynh-Feldt correction (Table 7), it can be seen that the influence of colour temperature on quality perception was statistically significant at the level of $\alpha = 0.05$ ($F(3.86; 767.44) = 7.280$; $p = 0.000$). Considering the limit ε value in terms of the choice of correction, the statistical significance of the F-value, after the application of Greenhouse-Geisser correction, was tested and it was concluded that, in this case, the F-value at the level of $\alpha = 0.05$ was statistically significant ($F(3.77; 751.11) = 7.280$; $p = 0.000$).

Table 7 Test results of the first hypothesis

Source of variability		Sum of squares	df	Square mean	F - value	p - value
Treatments	**Greenhouse - Geisser correction**	52,207	3,774	13,832	7,280	0,000
	Huynh – Feldt correction	52,207	3,856	13,537	7,280	0,000
Error	**Greenhouse - Geisser correction**	1427,127	751,110	1,900		
	Huynh – Feldt correction	1427,127	767,440	1,860		

Source: the authors' calculation

After proving that the differences in arithmetic means of the treatment existed, a post hoc test with the Bonferroni correction was performed. Based on the results of the post hoc test, with 5%, risk of error, it can be concluded that there is a statistically significant difference between the average values of the dependent variable "quality

perception", between treatments with light colour temperature of 2200 Kelvin and 3000 Kelvin (p = 0.002), 2200 Kelvin and 4230 Kelvin (p = 0.000), 2200 Kelvin and 5400 Kelvin (p = 0.039), 2700 Kelvin and 4230 Kelvin (p = 0.006), 4230 Kelvin and 6500 Kelvin (p = 0.000) and 5400 Kelvin and 6500 Kelvin (p = 0.042).

The post hoc analysis of pairs of arithmetic means, for whose differences was determined that there was a statistically significant difference, along with the application of the Bonferroni correction, at the level of significance $\alpha = 0.05$, leads to the conclusion that shoppers of Serbia perceive the product as a higher quality product, when the observed product is illuminated:

- with the light colour temperature treatment of 3000 Kelvin (4.81), in comparison to the treatment of 2200 Kelvin (4.41);
- with the light colour temperature treatment of 4230 Kelvin (5.00), in comparison to the treatment of 2200 Kelvin (4.41);
- with the light colour temperature treatment of 5400 Kelvin (4.80), in comparison to the treatment of 2200 Kelvin (4.41);
- with the light colour temperature treatment of 4230 Kelvin (5.00), in comparison to the treatment of 2700 Kelvin (4.57);
- with the light colour temperature treatment of 4230 Kelvin (5.00), in comparison to the treatment of 6500 Kelvin (4.48);
- with the light colour temperature treatment of 4230 Kelvin (5.00), in comparison to the treatment of 6500 Kelvin (4.48); and
- with the light colour temperature treatment of 5400 Kelvin (4.81), in comparison to the treatment of 6500 Kelvin (4.48).

Based on the comparison of pairs of arithmetic means, it can be concluded that shoppers in Serbia perceive the observed product as better when illuminated with the light colour temperature treatments of 3000 Kelvin, 4230 Kelvin and 5400 Kelvin, compared to the light colour temperature treatment of 2200 Kelvin, as well as in the case of 4230 Kelvin treatment, in relation to the treatment of 2700 Kelvin, and the treatments of 4230 Kelvin and 5400 Kelvin in relation to the treatment of 6500 Kelvin. Considering the dichotomy between the preference for a warm or a cold light colour temperature, in all three cases (4230 Kelvin versus 2200 Kelvin, 5400 Kelvin versus 2200 Kelvin, and 4230 Kelvin versus 2700 Kelvin), in terms of quality perception, we can conclude that shoppers on the Serbian market perceive the product as higher quality goods when the product is illuminated by treatments that lean towards a "cooler" temperature of the lighting.

Accordingly, we conclude that the first hypothesis is accepted.

3.2 Second hypothesis: The colour temperature of the lighting affects the shopper's perception of the product price

To test the second hypothesis, as in the case of the first hypothesis, the statistical technique of one-factor repeated measures analysis of variance was used. As in the previous case, an examination of the assumptions, necessary for the application of the aforementioned statistical technique, was conducted.

Assumptions regarding data type and independence of observations were fully met.

To test the assumption of normality, as in the case of the first hypothesis, the Shapiro-Wilk test was applied. It is concluded that, with an risk error of 5%, we reject the null hypothesis regarding the normality of the distribution of the observed effects, because all effects the p-values were lower than the significance level $\alpha = 0.05$.

However, as already specified, the statistical technique of one-factor repeated measures analysis of variance proved to be robust for large samples ($n = 200 > 30$), and on this basis, as in testing the first hypothesis, the verification of the sphericity assumption was continued.

The Mauchly test was conducted to examine the assumption of data sphericity.

According to the results of the test in question, and with 5%, risk of error, the rejection of the null hypothesis of sphericity can be concluded ($\chi^2 = 102.68$; $p = 0.000$).

Based on the rejection of the sphericity hypothesis, since the value of $\varepsilon = 0.815 > 0.75$, the Huynh-Feldt correction was chosen to check the statistical significance of the F-value. After applying the Huynh-Feldt correction at the level of $\alpha = 0.05$, the conclusion is that the influence of colour temperature on price perception is not statistically significant ($F(4.17; 829.74) = 1.871$; $p = 0.111$).

According to the above, it can be concluded that the second hypothesis is not accepted.

4. Discussion

The discussion below represents a result of hypothesis testing and comparison of the research outcomes with the other authors' dealing with the topic in question.

4.1 First hypothesis: The colour temperature of lighting affects the shopper's perception of product quality.

Shoppers in Serbia give higher ratings of product quality when the observed product is illuminated by the treatments of a cold colour temperature, while lower ratings of product quality are given when the observed product is illuminated by the treatments of warm colour temperature.

The results obtained for the Serbian market are in accordance with the research conducted by Creusen, Pont and Schoormans (2017), which concludes that respondents favour a cold colour lighting temperature (4000 Kelvin) more than warm temperature of the light colour (2700 Kelvin). Oberfeld, Hecht, Allendorf, and Wickelmaier (2009) came to the similar conclusion, stating that cold colour lighting temperature inclining toward blue light affects the fact that respondents perceive the quality of the observed product as higher than the lighting with the characteristic warm colour temperature of lighting. Han and Suk (2019) state that the conclusion that a cold lighting colour temperature gives better results in terms of perception of dependent variables seems atypical, i.e. contrary to the expectation that warm colour temperature should be associated with higher ratings given by the respondents.

4.2 Second hypothesis: The colour temperature of the lighting affects the shopper perception of the product price

The analysis of the results of this research produced the conclusion that the second hypothesis, regarding the influence of lighting colour temperature on the shopper perception of the product price, was not confirmed in the case of the market observed.

This conclusion remains in line with the conclusions of certain studies. Thus, the research conducted by Zielke and Schielke (2016) did not confirm that lighting colour temperature affects the perception of product price; Otterbring, Lofgren and Lestelius (2014) came to the same conclusion.

Conclusion

Based on a review of the literature, it can be concluded that lighting has a significant impact on shoppers' behaviour and emotional responses. In addition to the general observation of lighting, the focus of the researchers was placed on the colour temperature of lighting as well, as one of very important characteristics of lighting.

Briand and Pras (2013) state that shoppers express a higher degree of satisfaction when they are in a retail facility that is illuminated by warm colour temperature of lighting, compared to a cold colour temperature treatment. The term warm light colour temperature is usually associated with a light colour temperature of less than 3000 Kelvins, while a cold light colour temperatures are associated with temperatures above 3000 Kelvin (Babin, Hardesty & Suter, 2003). Yilmaz (2018) states that retailers can increase the degree of shopper satisfaction by using lighting systems that represent a combination of general and direct (directional) lighting systems, i.e. combining different colour temperature levels of lighting within these systems. According to the works of Tantanatewin and Inkarojrit (2016) and Schielke and Leudesdorff (2015), it can be concluded that shoppers express a higher degree of satisfaction in terms of combining different lighting systems with different levels of colour temperature, in terms of warm and a cold lighting temperature.

In addition to the shoppers' emotional response, some research suggests that colour temperature also affects shopper's behaviour. Custers et al. (2010) state that colour temperature can influence changes in shopper's movement patterns within a retail facility. According to Briand Decre and Pras (2013), colour temperature of lighting can affect the time spent in a retail facility. Colour temperature of lighting is negatively correlated with the shopper's time spent in the retail facility, which means that, in the conditions with the characteristic cold colour temperature, shoppers will spend less time in the retail facility. This conclusion may affect the fact that, due to the less time spent in the retail facility, shoppers can potentially buy a smaller number of products, thus negatively affecting the business results of a retailer.

The results of the research for the Serbian market point to the conclusion that the first hypothesis is accepted, i.e. that colour temperature of lighting affects the shopper's perception of product quality. Looking at the lighting temperature treatments in relation to whether they refer to cold or warm colour temperature, the conclusion is that shoppers of Serbia prefer cold colour temperatures.

The analysis of the results in this research led to the conclusion that the second hypothesis

regarding the influence of colour temperature of lighting on the shopper's perception of the product price is not confirmed for the Serbian market.

When drawing conclusions and making recommendations for future research, certain research limitations should be taken into account. These research limitations are listed below, along with the recommendations for further research.

The influence of lighting on the behaviour of retail shoppers was investigated only on the basis of one characteristic of lighting, i.e. lighting colour temperature. Thus, based on this limitation, it would be useful to use the same methodology in order to investigate the impact of other lighting characteristics, such as brightness level and colour rendering index, on the behaviour of retail shoppers on these markets.

Through the online research, based on the displayed photos of the product, the respondents evaluated the perception of quality and price perception of the observed product. This type of research could be very useful when comes to importance of retail digitalization (Grubor, Đokić & Milićević, 2017; Končar & Leković, 2016; Nuševa and Marić, 2017; Končar, Grubor & Marić, 2019). Also, the influence of pandemic caused by the spread of a new coronavirus affects both changes in shopper behaviour and changes in retailer behaviour. A large percentage of shoppers will switch to online shopping because of fear of the consequences that may arise from shopping in retail outlets (Petković, Dokić, Stojković & Bogetić, 2020). According to the research cited in the research methodology, many authors support the use of photographs to assess shopper preferences for certain products, but, of course, all authors agree that this way of research is very similar to the research in real conditions (Engelke, Stokkermans & Murdoch, 2013). Therefore, as a recommendation for future research, a research design where, in laboratory conditions, respondents observe a real product illuminated by different lighting treatments, would be very useful.

The subject of observation was only one product (apple). Apple, as a product belonging to the category of fruits and vegetables, was chosen because of the intention to avoid the potential connection of the respondents to the brand, and thus giving biased answers to questions regarding the perception of quality and price. Nevertheless, according to the review of the relevant literature, it can be concluded that the authors use a wide range of products from different product categories as the subject of observation (Quartier, 2011). Therefore, due to the greater possibility of generalizing the results, the recommendation for any future research would be to continue with the similar methodology, using more products from different categories as the subjects of evaluation.

Six treatments were used in order to create the lighting colour temperature treatment. The justification for selecting the six lighting colour temperature treatments cited in this study can be found in the literature describing the most common light sources in retail outlets specializing in the sale of consumer goods. The literature usually cites two lighting colour temperature treatments (warm and cold). The use of multiple treatments is justified because of the fact that the average subject can see a difference in light colour temperature of 28 Kelvin at a light colour temperature of 3000 Kelvin, 75 Kelvin at a light colour temperature of 4000 Kelvin, 122 Kelvin at a light colour temperature of 5000 Kelvin, and 192 Kelvin at a light colour temperature of 6500 Kelvin (Bieske & Vandahl, 2008). The recommendation for future research is to use fewer lighting treatments, and to compare such research with research that includes more treatments, all in the scope of the impact of lighting on retail shopper's behaviour.

Only one light source (LED bulb), which had the ability to regulate the light colour temperature, was used to create light colour temperature treatments. The justification for this approach was the effort of researchers to keep other lighting characteristics, such as brightness and colour rendering index, constant (Feng, Xu, Han, & Zhang, 2017). The treatments were defined on the basis of the colour temperature of the lighting, which was emitted by artificial (electric) light sources mostly used in retail facilities. Minor corrections in achieving the desired lighting colour temperature were made with the help of computer software. Based on the abovementioned, the recommendation for future research would be to use several different light sources when photographing the product. This recommendation correlates with the first recommendation concerning the inclusion of multiple lighting characteristics in the research.

Finally, as one of the limitations of the research comes the possibility that the screen characteristics of the device, through which the respondent accesses the questionnaire, produce a different product image and lighting colour

temperature, due to different screen resolution. Although some authors claim that there is no difference in colour representation on different screens (Quartier, 2011), this limitation is relativized by sample size, which was created with the help of a reputable market research agency, hired for the purpose of greater representativeness. In addition, in order to relativize this limitation, the study involved respondents who accessed the questionnaire exclusively through a desktop computer, thus excluding the possibility of using other devices, such as a mobile phone. Recommendation for future research would be the identification of the device by which the respondent accessed the questionnaire, and the subsequent comparison of the obtained results, according to the device by which the respondent accessed the questionnaire.

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✉ **Correspondence**

Dejan Tešić

University of East Sarajevo, Faculty of Economics Brčko Studentska 11, 76101, Brcko, Bosnia and Herzegovina

E-mail: dejan.tesic.efb@gmail.com