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The impact of parameters of store illumination on food shopper response

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ABSTRACT

Customer behavior in sales areas is strongly influenced by the perception of surroundings and feelings of well-being. By using dynamic retail solutions of basic, accent and dramatic lighting it is possible to attract attention, create a unique in-store environment and give customers a reason to stay and return to the store. The simplest and also the most successful method to reach customer attention in food selection (buying) process is through eye-catchingly illuminated visuals of products. Visual senses has evolved to top ranks in the sensory hierarchy, therefore visual stimuli have a tendency to overcome all other senses. The paper deals with a comprehensive interdisciplinary research of the influence of light and color on the emotional state of consumers (valence) on the food market. It integrates the measurement of light intensity, color temperature or emitted color spectrum in grocery stores, recognition of emotional response and the time of its occurrence among respondents due to different lighting types and color in simulated laboratory conditions. The research is focused on accent lighting in the segment of fresh unpackaged food. Using a mobile 16-channel electroencephalograph (EEG equipment) from EPOC company and a mini camera we observed the response time and the emotional status (valence), in order to reveal true consumer preferences in different lighting conditions (color temperature and color rendering index) and their non-traditional color (yellow, purple, red, blue and green) for the selected food type. The paper suggests possibilities for rational combination of the effective, efficient and energy-saving accent lighting, by which the retailer can achieve not only an eye-catching and attractive presentation of merchandised products, but also significant savings within operating their stores.

1. Introduction

An important sensory element of consumer perception is a complex visual system, which is greatly influenced by lighting (Pradeep, 2010). Bitner (1992) defined lighting as an interior aspect, while Turley and Milliman (2000) include lighting in their review of atmospheric research in retail environments. Light can draw attention to products (LaGiusa & Perney, 1974; Quartier, Christiaans & Van Cleempoel, 2009) and lighting influences their attractiveness in a store (Habel, Dvořáček, Dvořáček, & Žák, 2013; Magnum, 1998). Light reflected from surrounding objects is received through the eyes of consumers, while the very sight is the result of brain processes. Light allows the perception of surroundings, moreover its parameters (intensity, color temperature, color rendering index) greatly affect the perception of the interior and the psychical state of the consumer (Pradeep, 2010). The recommended level of overall store lighting is between 100 and 1000 lux (Horská & Berčík, 2014). The lower limit is typically used in shops where the overall lighting is more combined with accent lighting, which is used to highlight the goods. In order to have a sufficient effect of accent lighting, it is important that the highlighted product is at least five times brighter than the surroundings, i.e. the factor of accent should be at least 5:1 (Habel et al., 2013). One of the essential requirements of the store area is the natural perception of colors of displayed products that can be ensured by light sources, which have color rendering index at least $R_a \geq 80$. For certain types of goods, such as fresh foods, lamps with special spectral composition are used that highlight certain colors (Kuller, Ballal, Laike, Mikellides, & Tonello,

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2006). The choice of color temperature has a very significant impact on the overall atmosphere of the store, but also on the perception of displayed products (Knez & Kers, 2000). Each type of product has a certain color temperature range (e.g. for bakery products it is 2700–3000 K) in which it is perceived naturally (Habel et al., 2013). Bright lighting conditions catch attention for products more often than 'dim lighting' conditions (Areni & Kim, 1994; Summers & Hebert, 2001).

Park and Farr (2007) indicated that consumers were aroused and pleased by certain lighting effects in a retail environment. As consumers and markets are changing at an incredible speed, retailers are trying to use innovative ideas to differentiate themselves from their competitors (Hallbauer, 2008). This is the reason that one of the key requirements of operating equipment of modern retail stores is quality lighting which enhances the image of these stores, positively affects consumer perceptionfocuses attention on the offered products and ultimately increases sales (Nagyová, Berčík, & Horská, 2014). Characteristics of the used lighting can be designed in various ways in grocery stores. They thus contribute to the impression about the visual quality of the environment at the point of sale as a whole, but also can be used with the aim of improving the attractiveness of offered products. Today, almost all grocery stores are equipped with basic lighting, which is mainly in large sales stores complemented by accent lighting. To ensure the proper accent lighting of fresh products, it is essential to select a protective filter against light radiation as well as the right combination of lighting parameters, because some lighting types distort color, which often reduces the visual attractiveness of the merchandised products. The aim of the paper is to use an interdisciplinary approach in surveying the impact of color temperature as an essential factor of lighting on consumer perception by creating consumer-attractive presentation of goods.

2. Theoretical background

Light and lighting represent a fundamental reason of human existence. It dictates our everyday activity, influences our mood and the way we perceive things around us (Brooker, 2003). Whether lighting can be framed within the definition of 'atmospherics' remains vague in research up to now (e.g. Baker, 1986), however, there are also reasons why store lighting can be considered an important determinant of store atmosphere (Borusiak, 2009). The term "atmosphere" reflects the influence of sensory stimuli of the environment like sight, hearing, smell and touch on the target consumer behavior (Kotler, 1973–1974). Even though lighting is only part of the overall atmosphere it can effectively affect consumer behavior. Many factors intertwine when forming the overall atmosphere, which influences the subconscious through senses as well as maintaining a certain customer's state of mind (Varley, 2014). The moment when the customers make their decisions is to a considerable level affected by what they see, hear, smell and touch in their surrounding (Kang, Boger, Back, & Madera, 2011). Emotions and feelings are primary medium for consumer decision-making system (Pham, 2004). An emotional state describes a psychological and physiological state in which typically emotions and behaviors are interrelated within a context (Scherer, 2005). Based on the psychological aspects, there are two theoretical approaches to the analysis of emotions, the discrete model and the dimensional model, while both are used for systematical and multilateral analyses of emotions (Phillips, Drevets, Rauch, & Lane, 2003). In the discrete model, an emotional state is defined as a set of a finite number of discrete states comprising several core emotions, including anger, fear, disgust, surprise, happiness, and sadness, or a combination of them (Barrett, 1998; Russell, 2003). We take into consideration the dimensional model which defines an emotional state spatially with the basic dimensions of emotion such as valence and arousal and interprets an emotion through the levels of each dimension (Mauss & Robinson, 2009). Based on the emotion models, neurophysiologic mechanisms under the emotional state have been thoroughly investigated. Broadly, it has been documented that the emotional processes performed at the ventral and dorsal systems in the human brain are functionally different (Phillips et al., 2003; Rilling & Sanfey, 2011). The ventral system, including ventral anterior cingulate gyrus and some ventral areas of prefrontal cortex (ventromedial prefrontal cortex and medial orbitofrontal cortex), is involved in the production of emotional states and the regulation of affective responses, whereas the dorsal system, including dorsal anterior cingulate gyrus, some dorsal areas of prefrontal cortex (dorsolateral, posterior dorsolateral, and mid-dorsolateral prefrontal cortex), and hippocampus, is involved in effortful emotion regulation and subsequent behavior (Frantzidis et al., 2010; Luneski, Konstantinidis, & Bamidis, 2010). Neurophysiologic measurement based on electrophysiological and neuroimaging techniques can detect a wide range of dynamics of the emotional state by directly accessing the fundamental structure in the brain from which an emotional state emerges (Mauss & Robinson, 2009; Panksepp, 2012). The still relatively new field of research in affective brain-computer interaction attempts to detect emotion using electroencephalograms (EEGs). There have been several approaches to EEG-based emotion detection, but there is still little consensus about definite conclusions (Chanel, Kronegg, Grandjean, & Pun, 2006; Choppin, 2000). Finding EEG correlates of emotional states should begin with defining the emotional state space, which can be largely categorized into a discrete space and a continuous space. In this paper we focus on the continuous state space, which is built from the dimensional emotion model and represents an emotional state as a vector in a multidimensional space. For instance, the circumplex model, developed by Russell, describes an emotional state in a two-dimensional circular space with the arousal and valence dimensions (Schaefer, 1959). Various psychological models define emotional dimensions that subsequently constitute the basis for the emotional state space (; Hamann, 2012; Fontaine, Scherer, Roesch, & Ellsworth, 2007; Mehrabian, 1980; Russell, 2003).

The frequency of EEG measurements ranges from 1 to 80 Hz, with amplitudes of 10–100 μV (Kandel, Schwartz, & Jessell, 2000). Signal frequencies have been divided into different bands, since specific frequency waves are normally more prominent in particular states of mind. The two most important frequency waves are the alpha waves (8–12 Hz) and the beta waves (12–30 Hz). Alpha waves predominantly originate during wakeful relaxation mental states, and are most visible over the parietal and occipital lobes. Intense alpha wave activity have also been linked to brain inactivation. Beta wave activity, on the other hand, is related to an active state of mind, most prominent in the frontal cortex during intense focused mental activity (Kandel et al., 2000). Alpha and beta wave activity may be used in different ways for detecting emotional (arousal and valence) states of mind in humans. Choppin's approach is based on emotional valence and arousal by characterizing valence, arousal and dominance from EEG signals. He characterizes positive emotions by a high frontal coherence in alpha, and high right parietal beta power. Higher arousal (excitation) is characterized by a higher beta power and coherence in the parietal lobe, plus lower alpha activity, while dominance (strength) of an emotion is characterized as an increase in the beta/alpha activity ratio in the frontal lobe, plus an increase in beta activity at the parietal lobe (Choppin, 2000).

The role of emotions in consumer decision-making process is explained by the principle of neurological and cognitive frames such as the theory of somatic markers (Reimann & Bechara, 2010),