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FaceReader as a neuromarketing tool to compare the olfactory preferences of customers in selected markets

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Abstract

Purpose – The purpose of this paper is to examine FaceReader as a tool to compare the olfactory preferences of two selected countries. This paper examines the olfactory preferences of customers in the bakery department of a grocery store in the Slovak and the Spanish market.

Design/methodology/approach – The aim of this study is to examine subconscious/unconscious preferences in the selection of aromas suitable for the bakery department in the Slovak and the Spanish market. In this case, it is not a classical qualitative sensory testing of the perception of fragrances. The aim is to identify the associations of scents related to the selected sales department through images of the selected aromas. A special platform is used to obtain subconscious/unconscious feedback, which allows online collection of implicit feedback using the software FaceReader 7.

Findings – The authors noticed the different moods of the two groups of respondents when they answered the question about what they associate with the smell of bakery products. The Spanish respondents were slightly pleasantly disposed, while the Slovak respondents were slightly unpleasantly disposed. The smell of bakery products evoked more memories and emotions in the Spanish respondents than in the Slovak respondents, which can be explained by the higher pleasant mood. The main contribution of this work lies in the new opportunities to obtain feedback that can be used in marketing research and that rely not only on explicit but also implicit data. The extension of the methodological apparatus to implicit feedback presupposes some form of control of the data collected by the questionnaire. The use of biometric tools can represent an efficient alternative in terms of time and money to the use of neuroimaging tools in the selection/research of aromas for specific stores/departments.

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Research limitations/implications – It must be noted that the sample is small, and adequate conclusions cannot be made about entire population. Based on empirical findings and pandemic-related limitations, the authors plan to conduct similar research with real aroma samples and with even larger sample of tested respondents, considering weather, season, olfactory sensitivity (anosmia, hyposmia and normosmia) and participant fatigue (beginning and end of the week).

Originality/value – Today, marketers are facing the greatest challenge of how to attract consumers' attention. Every individual has a different perception of the shopping environment based on his own experience, beliefs and attitudes. This is why new marketing techniques and approaches are becoming increasingly popular in the marketing environment.

Keywords Consumer neuroscience, Scent, FaceReader, Smell, Aroma marketing

Paper type Research paper

FaceReader como herramienta de neuromarketing Para comparar las preferencias olfativas de los clientes en mercados seleccionados

Resumen

Objetivo – El objetivo de esta investigación es examinar FaceReader como una herramienta para comparar las preferencias olfativas entre dos países. Concretamente, examinamos las preferencias olfativas de los clientes en el departamento de panadería de un supermercado en el mercado eslovaco y español.

Diseño/metodología/enfoque – El objetivo de este estudio es examinar las preferencias subconscientes/inconscientes en la selección de aromas adecuados para el departamento de panadería en el mercado eslovaco y español. En este caso, no se trata de una prueba sensorial cualitativa clásica de la percepción de fragancias. El objetivo es identificar las asociaciones de olores relacionados con el departamento de ventas seleccionado a través de imágenes de los aromas seleccionados. Se utiliza una plataforma especial para obtener comentarios subconscientes/inconscientes, que permite la recopilación en línea de comentarios implícitos utilizando el software FaceReader 7.

Resultados – Observamos diferentes estados de ánimo de los dos grupos de encuestados cuando respondieron a la pregunta sobre qué asociaban con el olor de los productos de panadería. Los encuestados españoles estaban ligeramente más predispuestos hacia aromas más agradables, mientras que los encuestados eslovacos estaban ligeramente más predispuestos hacia aromas menos agradables. El olor de los productos de panadería evocó más recuerdos y emociones en los encuestados españoles que en los eslovacos, lo que puede explicarse por el estado de ánimo. La principal contribución de este trabajo radica en las nuevas oportunidades para obtener comentarios que pueden ser utilizados en investigaciones de marketing y que no solo se basan en datos explícitos, sino también implícitos. La ampliación del aparato metodológico para obtener comentarios implícitos presupone algún tipo de control de los datos recopilados mediante el cuestionario. El uso de herramientas biométricas puede representar una alternativa eficiente en términos de tiempo y dinero al uso de herramientas de neuroimagen en la selección/investigación de aromas para tiendas/departamentos específicos.

Limitaciones/implicaciones de la investigación – Debe tenerse en cuenta que la muestra utilizada es pequeña y no se pueden extrapolar conclusiones para toda la población. Basándonos en los resultados empíricos y con las limitaciones relacionadas con la pandemia, planeamos realizar una investigación similar con muestras de aroma reales y con una muestra aún más grande de encuestados, considerando el clima, la temporada, la sensibilidad olfativa (anosmia, hiposmia, normosmia) y la fatiga de los participantes (inicio y fin de semana).

Originalidad – Hoy en día, los profesionales del marketing se enfrentan al gran desafío de cómo atraer la atención de los consumidores. Cada individuo tiene una percepción diferente del entorno de compra basada en su propia experiencia, creencias y actitudes. Es por eso que las nuevas técnicas y enfoques de marketing se están volviendo cada vez más populares en el entorno del marketing.

Palabras clave Neurociencia del consumidor, Marketing de aroma, FaceReader, Olor, Fragancia

Tipo de artículo Trabajo de investigación

特定国家顾客的嗅觉偏好比较研究：基于神经营销工具FaceReader

摘要

目的 – 本文旨在探讨FaceReader在比较斯洛伐克和西班牙两个国家的顾客嗅觉偏好方面的效用。我们以斯洛伐克和西班牙市场一家食品杂货店的面点部门顾客为研究对象，考察其嗅觉偏好。

设计/方法/途径 – 本研究的目标是探讨在斯洛伐克和西班牙市场选择适合面点部门的香气时潜在的/无意识的偏好。与传统的定性感官测试不同, 我们旨在通过选定香气的图像识别与选定销售部门相关的气味的联想, 并通过FaceReader 7软件在线收集隐性反馈。

研究结果 – 我们观察到两组受访者在回答关于面点产品气味联想时的心境差异。西班牙受访者略带愉悦, 而斯洛伐克受访者略带不悦。西班牙受访者对面点产品的气味引起的记忆和情感更为丰富, 这可能是由更高愉悦心境所解释的。该研究的主要贡献在于提供了在营销研究中利用反馈的新机会, 该反馈不仅依赖于明确的数据, 还依赖于隐性数据。将方法学工具扩展到隐性反馈的前提是以某种形式对问卷收集的数据进行控制。在为特定商店/部门选择/研究香气方面, 相对于使用神经影像工具在时间和金钱方面的花费, 生物测定工具的使用可以作为高效替代。

研究局限性/启示 – 由于本研究的样本量较小, 因此不能对整个人口做出充分的结论。基于经验发现和受到大流行病限制, 我们计划进行类似研究, 使用真实的香气样本, 并考虑更大规模的受试者样本, 同时考虑到天气、季节、嗅觉敏感度 (嗅觉缺失、嗅觉减退、正常嗅觉) 和参与者疲劳程度 (周初和周末) 对受试者的影响。

原创性/价值 – 当今, 营销人员面临着吸引消费者注意的最大挑战。每个个体根据其自身经验、信仰和态度对购物环境有着不同的感知。因此, 在营销环境中, 新的营销技术和方法变得越来越受欢迎。

关键词 消费者神经科学, 香气营销, FaceReader, 气味, 香气

文章类型 研究型论文

1. Introduction

Aroma marketing is a new marketing tool that forms the shopping environment with potential to attract consumers' attention at a subconscious/unconscious level (to clarify the concepts we work with, there are generally three levels of the mind – conscious, subconscious and unconscious. The conscious mind is the level at which we think. For example, we decide what to have for lunch at the restaurant and so on. We are aware of what we are doing and what we are thinking about. Subconscious is where our brain stores things that we do not need to think about consciously, because our brain has already learned how to do them, like how to walk and so on. Unconscious is where our brain stores things that we are not aware of at all, like dreams or our fears and so on. We do not have control over them. They are hidden from our conscious mind (Ricee, 2023). A pleasant atmosphere in a store or selected sales department, owing to the influence of suitably chosen aroma, can fundamentally influence people's overall perception (mainly subconscious/unconscious), which will be reflected in the economic results (Schiffman and Wisenblit, 2019).

Marketing, like every discipline, evolves over the years. The modern field of consumer neuroscience is a current trend in marketing communication oriented towards multiple human senses at the same time. It uses biometric and neuroimaging methods to obtain subconscious/unconscious feedback which has a major impact on the consumer's decision-making process (Genco *et al.*, 2013).

These methods identify consumers' needs, to attract them and show them the advantages of particular product compared to competing one. Marketing industry (like any other) is facing the problem of visual and information overload. This makes consumers immune to traditional marketing activities and puts them in a state of "perception blindness" (Brinson *et al.*, 2018). Therefore, it is difficult to attract customers at the point of sale, which is usually the last opportunity to change their decision to buy a product.

People act based on emotions, which are the basis of human life (Kvajo, 2016) to deal with basic life tasks. Plutchik proposed eight basic emotions: anger, fear, sadness, disgust, surprise, anticipation, trust and joy. Ekman proposed seven, but he changed the number later to six: fear, anger, happiness, sadness, disgust and surprise (he skipped contempt) (Ekman and Cordaro, 2011). Later, Jack *et al.* (2014) found that disgust and anger share similar wrinkled noses, fear and surprise share raised eyebrows. Therefore, they proposed four human basic emotions: fear, anger, happiness and sadness, similarly to other authors (Wang and Pereira, 2016).

The basic emotions approach differs from the dimensional approach. In the second one, emotions are essentially the same, differing only in intensity or pleasantness (Ekman, 2003), whereas according to the first approach, emotions consist of a limited number of basic emotions. Dimensional models suggest that emotions are best understood within a dimensional space, most often a two-dimensional space involving valence and arousal. Emotional valence describes the degree to which an emotion is positive or negative, whereas arousal refers to its intensity, i.e. the strength of the associated emotional state. These models usually assume that valence and arousal are at least partially distinct dimensions (Feldman Barrett and Russell, 1999). In general, the emotional significance of a stimulus increases its processing (Zeelenberg *et al.*, 2006). Valence refers to the pleasantness or unpleasantness of an emotional stimulus. Almost all events and experiences, such as smell, sound, music, art and written or spoken language, can be classified according to this dimension as more or less positive or negative. Nevertheless, there is empirical evidence of existing asymmetries in the way in which people use positive and negative information (Vaish *et al.*, 2008).

Our choices, actions and perceptions are influenced by the emotions that we are experiencing at any given moment. Therefore, scientists began to think how to use this in marketing. Important is to understand what evokes emotions. Research has shown that scents can evoke memories even from many years ago (Herz, 2016). For marketers it is important to eliminate negative emotions, support the positive ones and motivate consumers to the purchase process. The area where the influence of scents on consumer behaviour can be seen is aroma marketing (Rimkute *et al.*, 2015). The smell is one of our most primal and profoundly rooted senses (Zaltman, 2003). With all the other senses, we think before we respond. With scent, our brain responds before we think (Vlahos, 2007). The crucial factor is using the right scent, its intensity and timing. The perfect combination of quality and presentation can increase sales by up to 25% in some cases (Berčík *et al.*, 2022).

The attractiveness of aroma marketing is growing, as it has been demonstrated how the implementation of a characteristic scent into any type of business influences customer perception, brand loyalty and increases profits (Bradford and Desrochers, 2009).

The article wants to demonstrate the benefits of neuromarketing in this field. Consumer neuroscience has a lot of possibilities here, as it allows recognition of consumer preferences by using innovative technology. It uses neurophysiological tools to understand events that are fundamental to marketing theory, like predictable and unpredictable buying, rewards, trust, willingness to pay, self-relevance, self-interest, memory or emotional engagement (Sánchez-Fernández *et al.*, 2021). It can complement traditional ways of getting feedback from people and acquiring customers very effectively (Berčík *et al.*, 2021b).

Presented paper is focused on the FaceReader as an innovative tool to examine subconscious/unconscious feedback of customers through research in the bakery department at two selected markets – Slovak and Spanish. The aim is also to find out which aroma is appropriate for the bakery department in the grocery store in these two markets. In conclusion, we offer some suggestions for improvements in practice that may help businesses decide whether to use this type of marketing or not.

However, our research was severely limited by the COVID-19 pandemic, and therefore it was necessary to change our research methods. We explored the use of standard methods combined with an innovative neuroscience tool in the field, making our research innovative.

2. Literature review

2.1 The importance of consumer neuroscience in marketing

Neuromarketing – or consumer neuroscience – combines perspectives of marketing, neuroscience, economics, decision theory and psychology. It uses brain imaging technology

to effectively disclose the underlying reasons for the behaviour of consumers and predict decision-making processes of consumers (Nilashi *et al.*, 2020; Miljković and Alčaković, 2010).

Neuromarketing allows understanding the unconscious drivers of choices (Harris *et al.*, 2018). In traditional marketing research, the methods for obtaining conscious customer feedback aimed at evaluating, understanding, predicting and analysing consumer behaviour have remained unchanged. However, the unconscious/subconscious consumer feedback cannot be measured by traditional methods such as surveys and interviews (Alsharif *et al.*, 2023a). The purpose of neuromarketing is to study, understand and analyse consumers' behaviour and decision-making mechanisms beyond the traditional methods (Stanton *et al.*, 2017). Focusing on implicit feedback, neuromarketing can provide more accurate results compared to classical tools relying on respondents' declarative statements. Companies that use it can be much more competitive than others (Berčík *et al.*, 2021a). The main advantage of neuromarketing are the ground-breaking findings that explain how the brain comes to conclusions, both consciously and subconsciously/unconsciously, and when they occur automatically, regardless of our logic (Horská and Berčík, 2017). Neuromarketing provides valuable knowledge about a person's neural and physiological responses, which it uses to better understand consumers (Ledger, 2020). Up to 95% of our decisions during buying process take place in the subconscious mind (Zaltman, 2003) or unconsciously. Emotions drive purchasing behaviour, and decision-making in general. Using neuromarketing, retail marketing therefore uncovers what motivates consumers to buy and, based on that, develops strategies that drive them to buy (Ledger, 2020; Miljković and Alčaković, 2010). As Kenning and Linzmajer (2011) claimed, consumer neuroscience can move marketing research to a completely new level. Human senses play significant role here because human brain reacts and evaluates products, advertisements and services through sight, touch, sound, taste and smell. They are important for making emotional connections. Brands often combine them in marketing activities (Ledger, 2020).

Consumer neuroscience uses psychological and neuroscientific methods to investigate marketing issues related to purchase behaviour, thereby offering a scientific explanation of consumer preferences and behaviour (Alvino *et al.*, 2020). The use of neuroimaging tools has opened the way for neuroscientific theories that can enrich the understanding of human decisions (Casado-Aranda and Sánchez-Fernández, 2022, p. 6). The new tools which significantly developed the neuromarketing field are mainly electroencephalography (EEG), functional magnetic resonance imaging (fMRI), eye-tracking, electromyography, galvanic skin response (GSR) and face reading (Alsharif *et al.*, 2021; Alsharif *et al.*, 2020). These tools/methods allow researchers to examine, understand, analyse and predict purchase behaviour (Alsharif *et al.*, 2021). Therefore, neuromarketing research is significant for the academic and industrial world to overcome the limitations in the traditional methods, such as consumer social bias (e.g. consumer choices can be affected by others) (Alsharif, *et al.*, 2020).

Accordingly, neuromarketing research tools and techniques can be divided into two main categories: biometric measurement (body responses) and brain measurement (brain responses) under the influence of marketing stimuli (Horská and Berčík, 2017). Many studies have used these methods to demonstrate the impact of aromas on brain activity. They have analysed human responses to the scents by using EEG signals (Pinto *et al.*, 2014), or they have examined the effects of aromas in terms of emotional mood and physiology (Warrenburg, 2005).

Thus, neuromarketing is very important area in the study of customers' neural and physiological responses, such as internal and external reactions to marketing stimuli and advertising (Alsharif *et al.*, 2023b).

2.2 Using consumer neuroscience in aroma marketing

Marketing communications are usually designed to appeal primarily to customers' visual sensibility. However, consumers' decision-making processes are often influenced by other

senses and are often emotional. New methods are needed to perceive accurate information about consumer perceptions and desires. Compared to traditional research methods, neuromarketing tools/methods provide more accurate and necessary information about consumer perceptions (Falk *et al.*, 2012). They are used to gain new insights into different aspects of brand perception (Esch *et al.*, 2012), product packaging (Reimann *et al.*, 2012), emotional response to advertising (Treleaven-Hassard *et al.*, 2010) and new product development (Ariely and Berns, 2010). They also allow us to examine the influence of different scents on affective and cognitive processes (Georgiopoulos *et al.*, 2018).

Marketers understand that audio and visual stimuli alone may be insufficient to convince customers (Lwin and Morrin, 2012). The sense of smell is considered to be the most important of all the senses, as it can generate uncensored responses to marketing stimuli. Aroma marketing as such is based on aromachology, which is the science that studies the psychological and physiological effects of inhaling scents. It uses scent technologies to explore the feelings and emotions evoked by scents that stimulate the olfactory pathways (Vlahos, 2007; Bradford and Desrochers, 2009).

The sense of smell is most closely associated with emotional reactions (Ehrlichman and Bastone, 1992). The olfactory bulb is directly connected to the limbic system of the brain, which is related to immediate emotions in humans (Wilkie, 1995). Scientific studies have shown that 75% of our emotions are created using smell (Bradford and Desrochers, 2009). Our olfactory memory is the most intense of all the senses. Only about 20% of olfactory perceptions are forgotten, and people keep even very old memories and feelings associated with the smell (Calvi *et al.*, 2020).

Today, marketers face the biggest challenge of how to catch the attention of consumers. Each individual perceives the shopping environment differently based on their own experiences, beliefs and attitudes. Therefore, with new techniques and approaches marketing focuses on examining consumer behaviour and the ways in which businesses can positively influence it. One of these methods includes the use of sensory stimuli. These stimuli directly influence consumers' sensory perceptions, which can influence their purchasing power at a subconscious/unconscious level. Because the sense of smell is one of our most primal senses, aroma marketing is increasingly being used for this purpose. The olfactory memory establishes links between smells and emotions. It connects all the senses to trigger the emotional response (Sen, 2019). Because breathing is an autonomous process, scents reach everyone. Aroma marketing has thus become big business, with specialised agencies doing clients in a wide range of environments (banks, car showrooms, fitness centres and hotels [Genco *et al.*, 2013]).

3. Materials and methods

The aim of the paper is to examine subconscious/unconscious preferences in the selection of aromas suitable for the bakery department in the Slovak and Spanish market. It is not a classical qualitative sensory testing of aroma perception. Our research distinguishes between conscious (explicit) feedback, obtained by traditional research tools such as questionnaire, and subconscious/unconscious (implicit) feedback, obtained by consumer neuroscience tools – in our case, it is the FaceReader. The purpose is to detect aroma associations related to the chosen sales department through images of selected aromas. Therefore, this special platform was used that allows the online collection of implicit feedback using the software FaceReader 7.

FaceReader is neuroscience tool for marketing analysis of consumer perception and behaviour. It belongs to the somatic biometric methods for obtaining secondary brain activity through non-verbal expressions of the facial muscles of respondents and based on the dilatation of eye pupils. Through this, implicit feedback can be obtained (Berčík *et al.*, 2021a). This software programme can analyse six basic facial expressions according to

different emotional states: happiness, sadness, anger, surprise, fear and disgust (Yu and Ko, 2017). The accuracy rate of the software in analysing emotions reaches 90% (Loijens and Krips, 2013); thus, it can show the emotions of participants reliably and immediately (Yu and Ko, 2017).

With FaceReader, the participant's face is recorded while watching some stimuli on the computer screen. Afterwards, the advanced computer programme places a virtual grid consisting of 500 points on the recording of the participant's face. Automated facial expressions recognition depends on emotion sensitive facial features such as eyebrows, mouth and nose. Certain factors can hinder the view of these units and interfere with the data quality, e.g. glasses, hats and hair that cover part of the face or forehead; heavy facial hair (especially if it hides the mouth); in some cases also facial jewellery. Some facial recognition software is calibrated on certain ethnicities and age groups and might not work well with others (Noldus, 2021).

Other variables that can be extracted from the data on facial expressions recognition may include – gaze direction: eyes looking to the left (right), left (right)-up (down), straight forward, up (down); gaze angle: horizontal (vertical); gaze direction in degrees; head orientation: change in head position from neutral in degrees; head position: horizontal (vertical/depth position) relative to the camera; emotional arousal (in some cases) (Cohn *et al.*, 2007). After that, "the advanced image processing algorithm calculates the points on the picture of the face (491 points/44 muscles) and as an outcome gives information about the different detected expressions of above-mentioned emotions" (Maison and Pawłowska, 2017, p. 311). The analysis measures micro-expressions to encode subconscious/unconscious responses based on facial muscle activity using a camera and image processing software. Facial expressions have several unchanging features that can be identified as a common indicator of any mood. This allows real-time measurement, it is highly subjective, and it is used as a complementary technique to other methods (Dincer, 2020). Similar solutions were in the study by Adamczyk and Kuźmicz (2021), conducted by Neurohm using iCode^{TM} and published in Neuromarketing YearBook 2022.

The size and selection of our sample was determined based on similar studies. Maison and Pawłowska (2017) used it on the sample of 100 respondents when testing images. Yu and Ko (2017) conducted graphic style testing on the sample of 120 respondents. Each survey is unique, and the size and selection of the sample of respondents must be adapted accordingly. However, it is usually recommended not to analyse samples with less than 20 participants (Nagel, 2014).

The aim of using the special platform was to obtain information about consumer preferences on the conscious as well as on the subconscious/unconscious level. Based on the international implicit association test and PCA analysis, we discovered that there are significant preference differences in scent perception between Slovakia and Spain. We decided to examine specific scent preferences in the bakery department in these two markets (Neurosmartology, 2021). Bakery department was chosen because it avoids differences regarding fresh products (fruits, vegetables, meat and fish) between different countries. Also, bakery is department with high impulsivity, especially in the case of sweet and salty pastries.

The survey was conducted via the platform Samolab.online in two different languages – Slovak and Spanish. Samolab.online is a modern form of interviewing (questionnaire surveys), where along with the classical feedback, it also monitors the facial biometrics and the reaction time of the respondents. It is available in different languages, and it is accessible on different electronic devices (PC, laptop, tablet and smartphone). It is a similar tool that can be modified as a platform for conducting z-Tree economic studies (Fischbacher, 2007),

which was used in the experiment by Kugler *et al.* (2019). The analysis of the recorded facial expressions of the respondents in the form of videos was realised by the FaceReader from the Dutch company Noldus. This software measures the conformity of facial expressions at 30 frames per second, on a scale of 0–1, with expressions associated with the six mentioned emotions (Den Uyl and Van Kuilenburg, 2005; Terzis *et al.*, 2010). It identifies emotional feedback (valence and arousal) of respondents based on the observable changes of the facial muscles with maximum accuracy. It identifies emotions as effectively as trained human observers (Terzis *et al.*, 2010) and accurately classifies both intended and unintended emotions (Den Uyl and van Kuilenburg, 2005).

For this purpose, FaceReader has been used in much research. We can mention Maison and Pawłowska (2017), who focused on the examination of Using the FaceReader Method to Detect Emotional Reaction to Controversial Advertising Referring to Sexuality and Homosexuality. Similar examinations, highlighting the importance of facial biometrics and micro-emotions, have been carried out further, for example, on smaller groups of respondents. One such survey focused on the selection of the most suitable aroma for a selected cafe in Slovakia was carried out on eight respondents (Berčík *et al.*, 2020). Another one was focused on exploring the perception of scents for Christmas greetings, where the research was complemented by EEG. It was conducted on 20 respondents (Chovancová, 2018).

Our survey was conducted on 103 respondents from the Slovak market and 95 respondents from the Spanish market. The Slovak research group consisted of 55 women (53%) and 47 (46%) men, and one (1%) respondent identified as other gender. Most (42%) were young people up to 24 years. Age category 25–34 years represented 34%. The age group 45–54 years represented 4%. 20% of participants did not specify their age. The Spanish research group consisted of 60 (63%) men and 33 (32%) women, and two (5%) respondents did not identify themselves. Most (46%) were young people between 25 and 34 years. People up to 24 years represented 40%. Group between 45 and 54 years represented 9%. 5% of participants did not specify their age. Sample selection and representativeness was affected by remote outreach to respondents and by the COVID-19 pandemic. Construct validity of the scale is based on a pre-test in which it was tested using factor analysis.

The survey involved 11 questions. The main goals were to find out which aroma is most suitable for the bakery department; if the respondents buy bakery products and where they buy them; what they associate the aroma of bakery products with; which scent they find most pleasant for the bakery department and rate the selected scents on a scale from 1 to 5.

To verify the reliability of the scale, we used Cronbach's alpha. It is a measure of internal consistency – how closely related a set of items are as a group. It is a measure of scale reliability (UCLA, 2022). Scale reliability was $\alpha = 0.73$, which we consider acceptable.

The last two questions were about the gender and age of the respondents. The survey itself was preceded by informing the respondents, instructions for proper camera setup, as well as filling out an electronic consent form for testing and recording biometric data. All in accordance with the Code of Ethics which is in accordance with the International Code ICC/ESOMAR (Code of Ethics of the Laboratory of Consumer Studies FEM SUA in Nitra from 2020).

The recorded responses and biometric data were processed through descriptive and inductive statistics in MS Excel 2013 and Matlab 2020, R Studio 2022 software environment. The Mann–Whitney test was also used. This non-parametric test allows two independent samples to be compared. Mann, Whitney and Wilcoxon separately improved similar non-parametric test that can determine whether the samples can be considered identical or not, based on their ranks.

The aim was to compare the responses of participants from both markets to see if there are differences. To facilitate comparison, the recorded responses were visualised using

wordle analysis, which is a visual presentation of words where the size of each word is proportional to the number of occurrences. This method is often used as a complementary research tool (McNaught and Lam, 2010). Conscious and subconscious/unconscious feedback was then compared. The emotional state (valence/attention) of the respondents may provide more accurate information about their real preferences in choosing aromas. These are calculated automatically by Face Reader based on the six recorded micro-movement (Berčík *et al.*, 2021b).

H1. We assume that there is statistically significant dependence between gender of the respondents and their choice of preferred aroma.

H2. We assume that there is statistically significant dependence between nationality of the respondents and their choice of preferred aroma.

Gender and nationality were incorporated in the hypotheses as an assumption that there are differences in aroma perception between gender (Doty and Cameron, 2009) and cultures, which was addressed in the study by Chrea *et al.* (2004), who examined the effect of culture on the relationship between psychological dimensions underlying aroma perception and categorisation. Also, by Ferdenzi *et al.* (2011), who examined the affective dimensions of aroma perception: A comparison between Swiss, British and Singaporean population.

4. Results

Our research examined the effect of a certain aroma on human perceptions – conscious and subconscious/unconscious using FaceReader. The aim of the online research was to find the most suitable scent for bakery department in grocery store at the Slovak and Spanish market. We developed survey – association test in Slovak and Spanish language and distributed it in both countries. We received data from 103 Slovak respondents and 95 Spanish respondents. The sample structure is representative in terms of gender (p-value = 0.032) and age (in the relevant observed age range of the working population) (p-value = 0.429) at an alpha = 0.05 significance level.

In the first stage, we found out that nearly 89% of Slovak and 94% of Spanish respondents regularly buy bread, savoury and sweet pastry. The higher second number can be caused by the fact that most of Spanish food is served with bread. Both groups used to buy these products in bakery and then in supermarket.

Another question was about what they associate the smell of bakery products with. Respondents shall write one word which comes to their mind first. In Figure 1, we can see that Slovaks associate it mainly with morning, bread, freshness, smell and crunchiness, and Spaniards associate it mainly with bread, hunger, tasty, sweet and flour.

In the next question (Figure 2), we asked respondents, which scent they consider the most pleasant for the bakery department in the grocery store. We offered them different scents with the photo. 45% of Slovak respondents and nearly 63% of Spanish respondents chose freshly baked bread. More than 26% of Slovaks and 20% of Spaniards chose coffee and cake aroma. 22.6% Slovak and 11.4% Spanish respondents chose chocolate scent. In both surveys, no one chose cookie. 5.7% of both Slovak and Spanish volunteers did not choose anything.

We verified both hypotheses in this question using statistical testing. Based on the Mann–Whitney test, we identified statistically significant differences between men and women in the selection of convenience of samples (p-value = 0.008). Within *H2*, we did not confirm the existence of statistically significant differences between nationalities (p-value = 0.34).

We tested separately both surveys to *H1* and found out that at Slovak market there exists statistical dependence between gender of respondents and preferred aroma. In case of

Figure 1.
Wordle analysis of association with smell of pastry by Slovak and Spanish respondents

Figure 2.
The most pleasant scent for bakery department in grocery store by Slovak (blue) and Spanish (orange) respondents

Spanish market, we find out that between gender of respondents and the choice of preferred aroma the statistical dependence does not exist.

Within *H2* the result is that in both countries there does not exist statistical dependence between nationality of respondents and their choice of preferred aroma.

Respondents also rated suitability of selected aromas for the bakery department in grocery store on the scale 1 (the least) to 5 (the most). The most suitable aroma according to the respondents of both countries is the freshly baked bread. In total, 97% of all Spanish and 87% of Slovak respondents rated this aroma as suitable or the most suitable.

Other aromas received lower results. The coffee and cake were rated as suitable or the most suitable by 77% Spanish and 45% Slovak respondents, the chocolate aroma by 65% Spanish and 45% Slovak respondents, the cookie aroma by 40% Spanish and 39% Slovak respondents. This aroma received highest rating with 3 (moderately suitable) – 45% in Spanish and 28% in Slovak survey.

In the third research stage, we were evaluating the subconscious/unconscious respondents' feedback using the FaceReader 7 software and analysed facial expressions during the surveys. The valence value from the results is going from −1 (unpleasant) to 1 (pleasant) where 0 is neutral. The arousal is going from −1 to 1 and represents intensity of emotional state. Firstly, we measured the overall mood of the Slovak and Spanish respondents during the whole testing. The emotional state of Spanish respondents was slightly higher than that of Slovak respondents.

We also measured overall mood during testing to see what they associated with the smell of baked goods. Spanish respondents were in slightly pleasant mood, while Slovak respondents were in slightly unpleasant mood. The emotional state can affect the responses. As mentioned above, the smell of pastry brought up more memories and emotions for Spanish than for Slovak respondents which can be influenced also by pleasant mood of Spanish respondents compared to unpleasant mood of Slovak respondents. We also saw different intensity of emotional state of Slovak and Spanish respondents during the time they were answering to question which scent out of four offered they find as the most pleasant for the bakery department. Emotional state of Slovak respondents was more intense compared to Spanish respondents.

In Figure 3, we can see presented valence ratings (emotional state) of Slovak and Spanish respondents connected to suitability rating of every scent for bakery department. Slovak

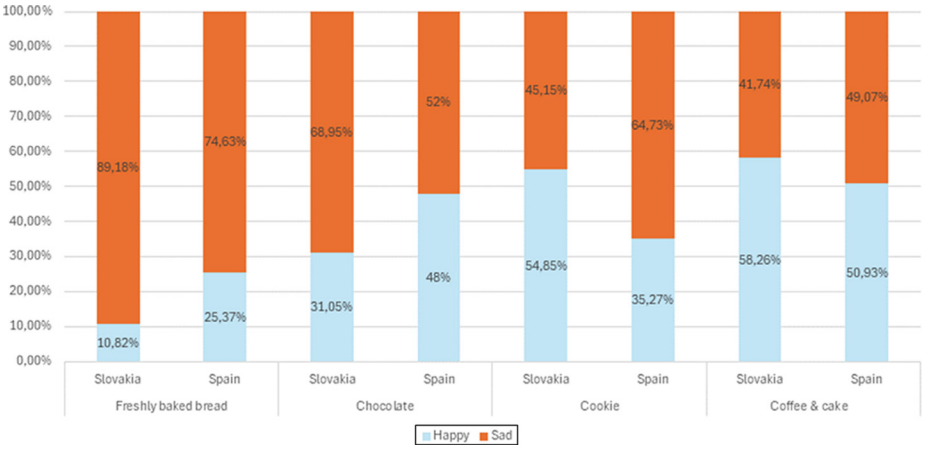

Figure 3.
Expression of the moods happy and sad of Slovak and Spanish respondents (question nos. 6–9)

participants were in notably unpleasant mood when rating the scent freshly baked bread and in notably pleasant mood when rating the coffee and cake scent compared to the time when they were rating other scents. Spanish participants were in unpleasant mood only when rating the scent freshly baked bread. In case of other scents, mood was pleasant but close to neutral. However, from the conscious feedback in survey, the freshly baked bread aroma was ranked as the most suitable based on most of the respondents from both countries, while the subconscious/unconscious feedback showed that this aroma was ranked as last (Table 1).

Table 1 shows the comparison of scent values with each other and between respondents from both markets. The software results show that Slovak respondents (13.42%) were happiest during the cookie aroma, while Spanish respondents (8.9%) were happiest during the chocolate aroma. The lowest values belonged to the freshly baked bread in both groups.

10.76% of Slovak respondents were angry during freshly baked bread aroma. 9.78% of Spanish respondents were most angry with coffee and cake aroma. Slovak respondents (3.42%) felt the highest disgust with freshly baked bread aroma. 2.86% of Spanish respondents felt disgust with cookie aroma.

We represented only emotions happy and sad of Slovak and Spanish respondents to compare different scents. 90% of respondents were sad with aroma freshly baked bread, followed by almost 70% with chocolate aroma. The respondents were happiest with coffee and cake scent, followed with cookie. The 75% of respondents were sad with aroma freshly baked bread, followed by 65% with cookie aroma. They were happiest in case of coffee and cake scent, followed by the chocolate scent.

Based on the obtained data, it would be better to avoid scent as freshly baked bread for the Slovak market. This aroma evoked emotions as sad, angry, scared, disgust for the higher percentage of respondents. The stores shall prefer scents like Coffee and Cake in the bakery department at the Slovak market. In case of Spanish market, it is better to avoid scents as freshly baked bread and cookie which evoked emotions as sad and disgust and reconsider the coffee and cake aroma to avoid angry emotion. On the contrary, they shall prefer scents like chocolate for bakery department. We need to consider that the emotional state of respondents during the research could be various which may skew the results.

5. Discussion

The main contribution of this work lies in the new feedback opportunities that can be used in marketing research and that rely on both explicit and implicit data. The use of biometric tools can represent an efficient alternative in terms of time and money to the use of neuroimaging tools in the selection/research of scents for specific stores/departments. Consumer neuroscience tools are relevant in aroma marketing as a subconscious/unconscious form of communication at the point of sale.

According to De Luca and Botelho (2021), research shows that odours affect consumers' behavioural, affective and cognitive responses to environments and products. Sensory and

	Freshly baked bread		Chocolate		Cookie		Coffee and cake	
Moods	Slovakia (%)	Spain (%)	Slovakia (%)	Spain (%)	Slovakia (%)	Spain (%)	Slovakia (%)	Spain (%)
Neutral	46.91	71.50	68.34	67.33	62.50	65.62	69.70	72.91
Happy	3.04	4.10	5.29	8.90	13.42	7.96	9.28	5.74
Sad	25.03	12.06	11.74	9.64	11.05	14.61	6.65	5.53
Angry	10.76	7.09	6.89	7.34	6.92	6.49	6.90	9.78
Surprised	3.97	2.31	3.60	3.32	2.76	1.27	3.65	1.99
Scared	6.87	1.09	2.95	1.78	1.92	1.19	1.77	2.10
Disgusted	3.42	1.85	1.18	1.69	1.43	2.86	2.06	1.94

Table 1. Percentage expression of Slovak and Spanish respondents' moods for all four scents

scent research have prioritised an emotional approach in which consumer responses are primarily affective reactions to smells. They propose that the unconscious odour interpretation better regulates consumers' responses to odours and behaviours than emotions and that the way in which olfactory information is cognitively processed and integrated into knowledge may address the extent to which odours help individuals to perceive their environment holistically and attribute meanings to events and social phenomena.

The right scent can positively affect consumer's behaviour. Consumers spend more time in a store when they can smell a pleasant scent. The longer time spent at the point of sale encourages more impulsive buying (Goldkuhl and Styvén, 2007). Spangenberg *et al.* (1996) stated that the presence of scent in a store may increase its arousing nature, enhancing how interesting and pleasant the environment is. Different studies have found several scent-induced approach responses such as stronger intent to visit a store, spending more time there, seeking variety (Mitchell *et al.*, 1995) and willingness to pay higher price (Spangenberg *et al.*, 1996; Vinitzky and Mazursky, 2011).

Therefore, it is essential to pay attention to the right usage of aroma in a store. An odour can be rated as pleasant depending on many environmental factors (Spangenberg *et al.*, 2005); however, intensity and timing belong among the other most important determinants.

Consumer behaviour is a subject of interest in many studies in different fields, which mostly focus on making products more attractive to consumers (Miljković and Alčaković, 2010). Many focus on the impact of aromas on consumer behaviour (Bradford and Desrochers, 2009) in various spheres. Similar research was conducted with bakery aromas. Bakeries and other shops have long been using bread aromas to support sales of bread in general. This aroma should lead consumers towards the bread department and increase sales. In their research, participants were exposed to images of bakery products without aroma and with aroma. The results showed that aroma had no effect on liking and wanting but influenced food choice behaviour. fMRI data suggested that bread aroma may increase saliency of bakery products compared to no aroma and non-food aroma (De Wijk *et al.*, 2018). Another research was conducted for BreadTalk Supermal using a questionnaire distributed among young people who visited this store. The scent was one of the essential elements to encourage consumers to visit, have experience and increase their purchase intent. The conclusion was that the use of appropriate retail environment and scent will create experiential marketing and behaviour that leads to purchase intention (Anggie and Haryanto, 2011).

Other research was realised in a French restaurant where lavender aroma was diffused and compared to a control condition without aroma. Lavender aroma caused customers to stay longer, make more purchases and spent more money, as they felt more relaxed (Guéguen and Petr, 2006). Another study was conducted at Brooklyn grocery market NetCost. They coordinated the scents according to preferences and different sections, such as placing rosemary near freshly baked bread, they saw at least a 7% growth in sales. Scents increased appetite beyond normal limits, and customers were more likely to buy food and spend money (Pulido, 2019). According to other researchers, those participants who were exposed to the smell of chocolate chip cookies were 40% more likely to buy something in the cafe compared to the participants who were not exposed to the aroma (Stranden, 2016).

Based on our research, we can state that the use of aroma marketing in business environment like, for example, bakery department in a grocery store, has a great potential to positively affect customers and improve economic indicators of the company. Aroma is a very powerful tool and sellers should carefully consider the use of ambient scent in their marketing strategies (Rimkute *et al.*, 2015).

Also, the use of various consumer neuroscience tools, such as FaceReader, is important for the deployment and application of aroma marketing in such companies, which can

significantly help in selecting an appropriate aroma, its dispersion and setting the right intensity of aromatisation. Because smell is associated largely with the reactions of the subconsciousness/unconsciousness, it may differ from the conscious one, without being perceived. Therefore, it is necessary to use different methods and tools for the right implementation of aroma marketing to achieve the best possible results.

6. Conclusion

Based on our research on the use of FaceReader to compare the olfactory preferences of selected countries, we can make several conclusions and recommendations:

- Spanish people are used to buy bakery products more often than Slovaks. Respondents are used to buy bakery products mostly in the bakery and supermarket. Most of the respondents from both markets think that bakery departments in the grocery stores are not aromatised. This can be because of the lack of knowledge about aroma marketing. It can be worthy to educate both professionals and the public in this field.
- Slovak respondents associate smell of pastry mostly with the morning, bread, freshness and smell. For some respondents, smell of pastry brings up childhood memories, parents' home, Christmas, time when they were studying also brings up feelings as euphoria, calmness. Spaniards associate smell of pastry mostly with the bread, hunger, tasty and sweet. For some of them, smell of pastry brings up memories of the childhood and mom, feelings as happiness, cosiness, tenderness and calmness.
- The questionnaire survey showed that the most pleasant smell for the bakery department in the grocery store is the smell of freshly baked bread in both Slovak and Spanish markets. However, according to the analysis of the respondents' facial expressions, this aroma evoked subconsciously/unconsciously mostly negative emotions such as sadness and anger.
- Most Slovak respondents rated coffee and cake aroma as slightly suitable and experienced the most pleasant emotional state with it. Most Spanish respondents rated cookie aroma as the moderately suitable. They ranked it as the best and were experiencing the most pleasant emotional state. However, high percentage of the respondents experienced sadness with this aroma. Sellers should avoid using aromas which evoke negative feelings. According to our results, for the Slovak market, we can recommend coffee and cake, chocolate or cookie aroma and for Spanish market chocolate or coffee and cake aroma.
- Based on dependence that we found at the Slovak market between gender and preferred aroma, and based on fact that women are more sensitive to scents, have greater capacity to identify scents, and are shopping groceries more often than men, we would recommend sellers to adapt the aromatisation in bakery department more to women preferences. Also, based on thought that men are shopping more in the morning, e.g. fast breakfast and women in the afternoon buying groceries for household, we recommend rotation of the aromatisation, when in the morning the scent will be more adapted to men and in the afternoon more to women.
- We noticed different moods during the time they were responding to the question what they associate with the smell of pastry. Spanish respondents were in slightly pleasant mood, while Slovak respondents were in slightly unpleasant mood, which could affect the responses. The smell of pastry brought up more memories and emotions for Spanish than for Slovak respondents, which may be related to the mentioned mood.

We can conclude that emotion recognition based on facial expressions is a reliable tool for obtaining implicit feedback, providing some form of control over respondents' answers obtained in the traditional way. The added value of this study lies primarily in the extension of the methodological apparatus in testing scent associations to the use of implicit feedback, which other studies do not consider.

6.1 Academic and practical implications

New methodological approaches using consumer neuroscience tools in marketing research can be considered as academic implications. Practical implications include the fact that in a competitive environment, added customer value or unique selling proposition, which can take the form of a pleasant shopping atmosphere, is coming to the forefront. The elements of the shopping environment are characterised by a common subconscious/unconscious effect, which means that the customer is not aware of their influence. However, their importance is great because they can create a positive experience for the consumer and help fulfil the retailer's goal of keeping the customer in the store longer with the expectation that they will buy more and return there again. Just as the sensory stimuli must be appropriately adapted to the offered goods, so their mutual compatibility must also be ensured. As the influence of scents is mainly subconscious/unconscious, retailers should use a combination of traditional forms of research with consumer neuroscience tools that provide detailed insight into the real person's emotions under the influence of particular scents to select the best one that will contribute to improving the customers' perception of the environment. The return on invested costs, assuming a positive effect of aromatisation, will be reflected in an increase in turnover in a given department, especially in bigger grocery stores, which will fully cover it.

6.2 Limitations and future research

We must note that our sample was small, and we cannot make adequate conclusions about whole population. Simultaneously, some distortion may have occurred by lighting conditions, which may affect the recognition of emotions based on facial expressions. Because of the pandemic measures, the research was conducted remotely without the possibility of smelling real aroma samples.

Based on empirical findings and pandemic-related limitations, we plan to conduct similar research with real aroma samples and with larger sample of respondents, considering weather, season, olfactory sensitivity (anosmia, hyposmia and normosmia) and participant fatigue (beginning and end of the week), under conditions of different air quality (CO_2, volatile organic compounds, temperature and humidity) to identify possible changes in aroma perception. This will also be simulated under the assumption of upper respiratory tract coverage to quantify the impact of pandemic restrictions (mandatory upper respiratory protection in indoor environments) under real conditions. This similar research should be conducted with a 32-channel EEG and its extension to include a biometric method for measuring skin resistance (GSR).

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