SLOVAK UNIVERSITY OF AGRICULTURE IN NITRA

THE USE OF AROMATIZATION AND SMART SOLUTIONS IN SELECTED ECONOMIC SECTORS

Jakub Berčík et al.

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Title: **The Use of Aromatization and Smart Solutions in Selected Economic Sectors**

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CONTENT

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INTRODUCTION

The publication *The Use of Aromatization and Smart Solutions in Selected Economic Sectors* provides the basis for a systematic review of the synergistic interplay between brain, physiological and psychological processes with aromachology, which is currently absent, as is an assessment of their economic efficiency and effectiveness in selected sectors of the national economy, namely manufacturing, trade and services.

Innovative research solutions and consumer neuroscience represented by biometric, neuroscience and behavioral studies in both real and laboratory conditions enable businesses to make more effective strategic decisions. Subject of interest is the investigation of the targeted impact of the deployment of aroma in spaces on behaviour of visitors, customers and employees, as in both domestic and foreign markets the number of companies implementing aroma technology (i.e. aromatizing their facilities or create brand olfactory traces) and at the same time practically apply it in various sectors.

The publication is important for future studies and investigations that can confirm the impact of scent on the economic efficiency of companies, influence on customers shopping or spending time in the shop, i.e. in the real shopping area. It also includes new relevant knowledge in this field not only by using the knowledge gained through biometric and neuroimaging methods, but also by involving new information and communication technologies.

The publication was supported by the Erasmus+ KA2 Strategic Partnerships project *"Implementation of Consumer Neuroscience and Smart Research Solutions in Aromachology" (NEUROSMARTOLOGY), no. 2018-1-SK01-KA203-046324*.

The publication is intended for researchers, professionals in the given field, commercial practice, as well as for the general public interested in examined issues.

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1 AROMACHOLOGY AND AROMA MARKETING & AROMATIZATION IN PRODUCTION LINE

1. 1 Introduction

The topic of air quality research in the workplace and the working environment is as important in terms of importance as the topic of outdoor air quality. However, for understandable reasons, ambient air quality is given disproportionately more attention at the global level, including global organizations and global figures, as it affects the climate worldwide. Over the last three decades, scientists, experts, NGOs and politicians, who have adopted global conventions and declarations have worked intensively on air quality around the world. A macro view of the issue of outdoor air quality has over time also entered micro-dimensions and currently takes the form of topics such as indoor air quality (IEQ), resp. indoor air quality (IAQ). Several research studies publish results on the effects of indoor office buildings on air quality on performance and productivity. The magnitude of this effect can be up to 6–9% (Wyon, 2001, 2004). At the present, several marginally discussed topics have not yet been sufficiently subjected to systematic research. One of them is targeted air treatment. There are only a few expert research studies that would provide information on targeted air treatment (other than ventilation) in the indoor environment in the production process and their interaction. Research in this area could help determine whether the treated air positively, resp. negatively consciously or unconsciously affects labor productivity, respectively safety at work. Published research shows that the indoor environment is important for human health and comfort (Zainon et al., 2016; Lu, 2014; Seppanen, 2006; Torresin et al., 2018).

1. 2 Sense of smell – Aromatherapy and Aromachology

Smell is the strongest human sense because it has a direct connection to those parts of the brain that control emotions, behavior, and certain types of memory. A smell can cause an immediate emotional response in humans (Lwin et al., 2015). Everyone can answer immediately whether they like the

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scent or not. Smells carry a message and affect people in such a way that they often do not even know that they are feeling something or smell something. This is a very important function from a marketing point of view. There is a basic process for sensing and perceiving the scents of the human brain. When capturing the scent, one perceives its pleasantness in the first place. It follows that aroma is not perceived analytically, but hedonistically (Herz, 2009).

As a result, there is a judgment of consciousness, i. e. whether a particular odor was perceived or not, and reminds a person of something. In the last step, one perceives its intensity (Lwin et al., 2015). Research has shown that the positive emotions resulting from the perception of a pleasant scent increase to a certain extent. On the other hand, there is a limit at which too strong an odor becomes unpleasant. The opposite procedure works similarly. After evaluating these characteristics of the perceived odor, one begins to think about what the odor is and where it comes from (Gulas et al., 1995). This affects the emotions before we can orient ourselves in them. The above procedure can be seen in Figure 1.1.

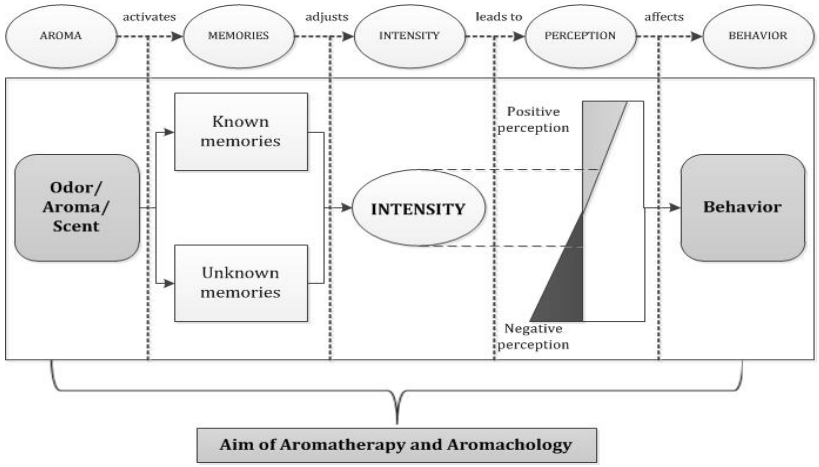

Figure 1.1 Purpose and progress of aroma perception
Source: Authors´ own elaboration

An interesting finding was the paper (Small et al., 2005), in which aroma is perceived by humans in both ways – nose and mouth. Aromatic molecules come into contact with the olfactory epithelium through the nose (orthonasal sniffing), it is the aroma of the outside world or through the mouth (retronasal sniffing), where the aroma comes from the mouth and is associated with taste as sweet, sour, salty, spicy and hot. The authors examined the difference in the perception of reference aromas: chocolate, lavender, farnesol (typical floral scent) and butanol (alcohol). The difference in sensitivity and pleasantness of these reference odors was found

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when passing through the nose or mouth. Odor stimulation is different, whether it is the smell of food or non-food (Small et al., 2005). Experiments have shown that the perception of the smell of the brain is different, whether it is perceived by the nose or mouth. The mentioned process of aroma perception is shown in the following figure.

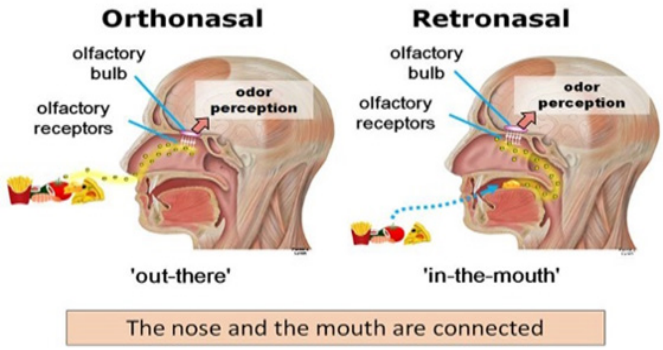

Figure 1.2 Differences between retronasal vs. orthonasal olfaction
Source: Quizlet, 2021

The main finding of the observed studies was that the same odor can cause different reactions in the human brain depending on whether they are sensed orthostatically, i. e. they pass through the nose or are sensed by the retronasal route, i. e. back of the mouth. This result supports the hypothesis that orthonasal and retronasal olfactory perceptions represent qualitatively different sensory experiences. This hypothesis is consistent with the specific pattern of differential activity observed in response to orthostatic and retronasal odor application. In contrast, it can be assumed that odor responses to orthonasal vs. retronasal olfactory stimulation. Because the study tested only one food (chocolate), further experiments are needed to see if other flavors produce the same differential brain activation. Concerning our experience and the topic of research, we address the issue of human perception of aroma through the nose.

In practice, we also encounter two basic views on the perception and evaluation of aromas by humans, namely aromatherapy and aromachology. Although these terms may look very similar, they differ in their content, i. e. flavor quality, priority purpose and use. However, both support positive effects on human mood and emotions, the former (aromatherapy) represents the therapeutic use of natural fragrances, while the latter (aromachology) is based on scientific studies and is closely linked to psychology (Herz, 2009; Tomi et al., 2011).

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Aromachology is based exclusively on scientific research that examines the psychological effects of natural and synthetic scents on humans. Aromatherapy is much older and in the past was an integral part of folk medicine. In contrast to aromachology – aromatic medicinal oils are mainly observed for their medicinal properties (Wang et al., 2005).

Aromatherapy is about the therapeutic use of natural scents and about bringing well-being (Johnson et al., 2016; Price – Price, 2012). Systematic research has also shown that aromatherapy is one of the popular complementary and alternative drugs and has also confirmed the beneficial therapeutic effects of aromatherapy on employees' psychological health, including improving work performance and reducing stress in the workplace (Damian, 1995; Ornelas – Kleiner, 2003; Huang – Capdevila, 2017; Andrews, 2021). Aromachology is based on scientific studies, examines the psychological effects of natural and synthetic scents on humans and is closely related to psychology (Herz, 2009; Van Toller – Dodd, 1992; Chu, 2000; Von Kempski, 2002; Sumegi – Ilona, 2018). Table 1 shows the basic differences between aromatherapy and aromachology.

Table 1 Differences between Aromatherapy and Aromachology

	Fragrance quality	Solves preferentially	Main purpose	Utilization
AROMATHERAPY	Natural	Launching and causing a specific physiological reaction in humans	Health status of individuals	In medicine
AROMACHOLOGY	Natural Synthetic	Launching and causing a psychological reaction in humans	Affecting the mood and behaviour of people	For commercial purposes - retail, work environment

Source: Authors' own elaboration

In general, the topics of research, analysis and application of both principles of aromatization, i. e. aromatherapy and aromachology of interiors has a different history and depth of research. It very much depends on the purpose of using these interiors. The most common are:

- Production;
- Administrative premises;
- Storage space;
- Grocery store;

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- Trade in non-food products;
- Services (travel agencies, real estate agencies, consulting services, banks, financial and insurance institutions);
- Gastronomic establishments (cafes, restaurants, bars);
- Hotels;
- Medical facilities;
- Wellness services, relaxation canters and fitness; and
- Educational institutions, media spaces, households and other unspecified spaces.

From the above-mentioned indoor spaces, aromatization (in the sense of aromatherapy) is commonly used in medical facilities, relaxation centres, fitness and other areas providing wellness services. Other services are used in households and administrative premises.

Research points to the use of aromatization (in terms of aromachology) of indoor spaces in which people use retail services, i. e. aromatization in the non-food environment (Morrison, 2011), (Jacob et al. 2013), (Suthaphot et al., 2012) and aromatization in the retail environment (Horská et al., 2018), (Davies et al., 2003). Although the surrounding odors in retail outlets have been shown to affect shoppers, examples of real-world odor effects are rare and the existing theoretical explanation for the observed effects is limited. Several results show how the emotional processes taking place during stimulus exposure differ in individuals with different olfactory abilities. The findings revealed an automatic mechanism for an individual's sensitivity to odor.

However, the topic of research and studies on the aromatization (in the sense of aromachology) of interior spaces, in which people work more manually, is a new area that science is currently beginning to pay attention to. Rather, the literature describes the impact of aromachology on employees in administrative premises, but published research results on the impact of aromachology in production premises are not available. There are no scientifically based studies and research that analyze and provide at least partial evidence of the impact of fragrances on the productivity and economic performance of companies. Nevertheless, the number of companies implementing aromachology is constantly growing. They modify their premises or create olfactory tracks of various brands, especially in retail, and thus indirectly positively affect the economic performance of their companies. These findings inspired us to study the available scientific literature in the field of aromachology research by focusing on the scents around the production areas and looking for links between air quality using internal aromatic substances and a possible link to work performance.

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1. 3 Aroma marketing and neuromarketing

Aroma marketing is a new modern direction in advertising, which works successfully abroad and multiplies the profits of companies. Aroma marketing is a relatively new marketing tool used by elements of neuromarketing, the aim of which is to aromatize the air in rooms to increase sales and have a positive impact on the customer as a whole. Despite its relatively young age, aroma marketing in the world is already showing good results.

In general, in various markets, aroma marketing boasts increased sales, increased repeat visits to target stores, increased customer loyalty to the brand, and increased demand. It is noteworthy in itself that 35% of Fortune 500 companies already use aromatherapy for advertising purposes, which means that this technique can help in the fight for a client (Denizci Guillet et al., 2019).

Smells create lasting memories that one subconsciously preserves and remembers olfactory sensations for several years. The smell is the only sense that is directly connected to the part of the brain that controls customer behaviour, certain types of memory and emotions. In addition, the sense of smell cannot be turned off (except from a health point of view, when a person loses this sense temporarily or is permanently dull, which is, for example, a side effect of COVID-19). Therefore, smell sensation evokes immediate, direct and subconscious emotional reactions. Most research has confirmed that visitors to appropriately flavored areas:

- perceive the quality of products/services as higher;
- they are willing to pay more;
- spend more time in space without realizing it (subjective perception of time changes);
- they will rather remember the watched brand and be more loyal to it.

The consumer makes a purchase decision not only on the basis of rational judgments but also on the basis of emotional reactions that he cannot control. This means that sellers, knowing the biochemistry of buyers' emotional reactions, can effectively influence all five organs of the human senses while bringing benefits to consumers and society. For businesses, the use of neuromarketing provides a way for consumers to understand and predict consumer reactions in any market environment. This means that neuromarketing allows you to look at the product through the eyes of consumers, study their biochemical emotional response and at the same time influence the five senses - touch, smell, taste, hearing and sight. This makes it possible to adapt the product to real cultural and social conditions while creating the unique value and individuality of the product, which

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remains in the minds of consumers as potentially desirable. Neuromarketing for consumers is also a great success, as excessive saturation of external information in today's people causes visual and audible fatigue and coming to the store is accompanied by feelings of chaos, social discomfort and reduced response. This causes an increase in blood pressure, an increase in heart rate, an increase in muscle tension and an increase in blood sugar, which makes a person irritable, angry and insecure, which leads to customers refusing to buy something. Neuromarketing contributes to customer satisfaction through a positive mood, comfort and friendliness of employees. It increases the ability to interact with consultants, facilitates purchasing decisions and increases consumer interest in new products. Neuromarketing research also enables consumers to get the product they want. Through neuromarketing research, society solves problems through happy and satisfied people's goods or services, and the economy is evolving much faster thanks to business profits. By using neuromarketing techniques and focusing on the socially responsible component, effective social projects can be developed (Stanton et al., 2016).

Enterprises and shopping malls usually flavor different spaces, specifically using certain scents. For example, shops smell of fresh baking, it activates the body's secretory functions at a subconscious level, and the potential consumer buys more products than planned, i. e. in supermarkets, these aromas are used exclusively to increase food sales; office scents are used to increase performance; public aromatizers – to reduce aggression, etc.

On the other hand, if a particular scent does not match the demographics, location, or brand identity, the public's reaction can often be negative. Just as aroma marketing can create a positive brand image, it can do the opposite, creating a negative image when used incorrectly. Before selecting the right fragrance for a selected research brand and practice, it is recommended to select testing in laboratory conditions or to select a specific aroma based on the recommendations of experts in the field (e.g. REIMA AirConcept GmbH, Meerane, Germany). If the customer is sensitive to odors, it can cause unpleasant reactions that make him uncomfortable. People from different cultures and ages have different associations with certain scents. What is pleasant for some can be unpleasant or even aggressive for others.

Marketing has always had and still has the place to implement and develop its activities where there are market changes. The economy cannot grow indefinitely in the conventional way we understand it today, and wherever new ideas can emerge. It is therefore short-sighted to follow only traditional competitors and traditional marketing tools (Petersen et al., 2015).

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1. 4 Aromatization in production line

The air quality of the environment in which people live, work, or shop is very important for their overall satisfaction and perception of the business. The worse the air quality becomes, the harder it is for store owners to keep customers in the store to spend as much time as possible and spend as much money as possible. The United States Environmental Protection Agency (1997) reports that indoor air quality is an important factor for businesses, managers, tenants and employees because it can affect the health, comfort, overall well-being and productivity of people in a building. Research confirms that polluted air and the environment and bad weather have an emotional impact on the human body and brain (Berčík et al., 2019).

There are several options that companies can implement to improve the air in their premises. From the use of zero-emission cleaners to the installation of the latest and greatest air filters to improve indoor air quality. The reason is to get the benefits that companies get by trying to reduce air pollution:

- less risky work environment for employees and customers,
- less likely to be sued or fined,
- cost reduction, which includes, for example, paying less insurance; less machine maintenance, mainly due to a cleaner environment, fewer particles that can damage machines; fewer claims for compensation from customers.

All opportunities to learn and increase safety should be used in hazardous work. For the development of work, it is important to know what is happening in the production hall – what kind of situational requirements exist, what are the work practices for workers, how to make efforts, etc. Accidents and incidents can be an important source of information to answer all these questions. The studies are carried out to provide both organizational and individual lessons learned from accidents. However, if learning can be derived from the changes made as a result of an accident investigation, learning seems to be less effective. Difficulties in learning and developing risky work do not depend on the source of the data - accidents or common situations. If anything, it depends on how we look at the data, the circumstances and the ability to support reflection. Accident studies can inform us about common practices and can point out vulnerabilities and strengths of the system (Berčík et al., 2019).

The authors of this chapter also were engaged with production line aromatization in real conditions, within their project activities. The main idea of the monitored activities was to systematically examine the synergistic connection of brain, physiological and psychological processes with aromachology, as well as their economic efficiency and effectiveness in

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selected sectors of the national economy: production, trade and services. These processes have been investigated through innovative research solutions and consumer neuroscience represented by biometric, neuroscientific and behavioural studies in real and laboratory conditions. The subject of interest is to examine the targeted impact of the use of aromas in the behaviour of visitors, customers and employees, as in the domestic and foreign markets the number of companies implementing aromachology (i. e flavouring their premises or creating olfactory traces of the brand) in various sectors. A significant benefit of the solved activities is the precise control of air quality factors on the one hand and their conscious influence on people, on the other hand, to reveal preferential changes associated with air quality. Combinations with other sensory perceptions, such as taste, light, color and sound, are also an essential part of aromachology research. Their contribution lies primarily in the form of new knowledge about the positive or negative perception of various aromas affecting several senses of man.

1. 4. 1 Practical example of research

The mentioned area of production was represented by the production process itself, within which the issue of the use of aromatization was processed to reduce accidents in production, increase labour productivity and improve the perception of the working environment. The research was carried out in an international company that manufactures and sells polypropylene fibers – *Chemosvit Fibrochem, s.r.o., Svit, Slovakia,* for a wide range of textiles industries. In addition to the above, it is engaged in the production of socks and hosiery. It was in the department of socks and hosiery production that long-term research was carried out (*July 31, 2019, to March 2, 2020*), the aim of which was to examine the impact of aromatization and air quality on an unconscious and conscious perception of employee satisfaction. The first half of the research took place without aromatization, in the second part an aromatization unit with *Energy* and *Fresh Office* aromas was deployed in the department. The selection of specific aromas was carried out in consultation with experts (aroma manufacturers, neurologists, psychologists), was tested in laboratory conditions before deployment and was subsequently approved by the company's management.

At the end of each shift, the task of the employees was to express feedback on the expression of satisfaction with the work environment at a special kiosk via a graphical scale. At the same time, information about their unconscious feedback and basic classification data were automatically recorded. The integrated camera took several frames per second each time feedback was transmitted, where using the so-called facereader monitored micro emotions and macro emotions of employees.

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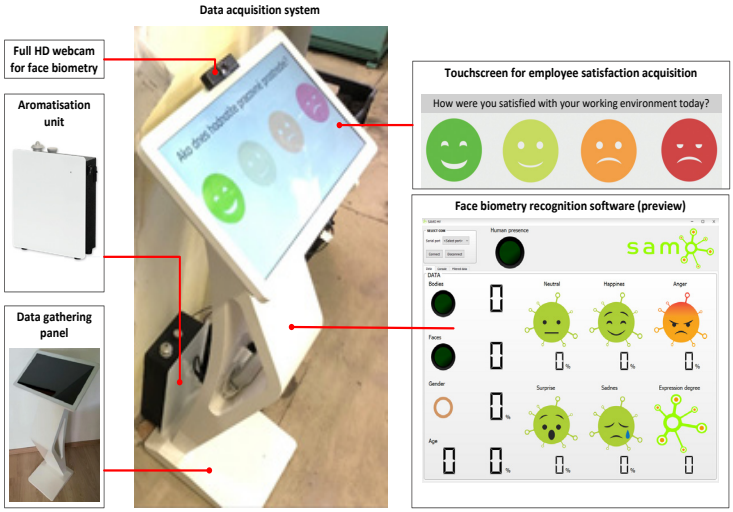

Figure 1.3 System (and its components) used to data acquisition
Source: Authors' own elaboration

The special software then compared the feedback they provided on the graphics scale with the recorded emotions. Facial biometrics made it possible to quantify several micro and macro emotions quantitatively. Valence and Arousal play an important role in the overall assessment of the employee's overall mood. Using information about Valence and Arousal, we obtained an important basis for the influence of selected aromatic compounds on the emotions of people in the work environment. The first phase of the research took place without aromatization of the premises during normal operation with air conditioning. In the second half of the research, the same data collection process took place, with the AromaStreamer® aromatization unit with selected aromas being placed in the working environment (Figure 1.4).

Figure 1.4 Aromatization unit and selected aroma to aromatization unit
Source: Aroma marketing, 2019

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The aromatization unit made it possible to regulate the intensity of the aroma in the room based on present values while working on the principle of cold evaporation of the fragrance filling - the so-called nebulization. Thanks to the built-in multifunction timer, the control of the unit from a remote location were easily accessible via the application in the mobile phone via the Bluetooth interface (Figure 1.5). The ability to adjust the intensity of the fragrance application guaranteed a consistent and optimal effect of the fragrance throughout the operating time. The aromatization unit was located in the production hall so that employees did not know about it and it did not affect their feedback. After consulting with the aroma manufacturer and also from the results we obtained based on tests in laboratory conditions, we were the first to apply Energy aroma to the aromatization unit. As mentioned, the unit was connected to a mobile phone via an application, where we adjusted the intensity of aroma dosing as needed, respecting the working conditions of employees.

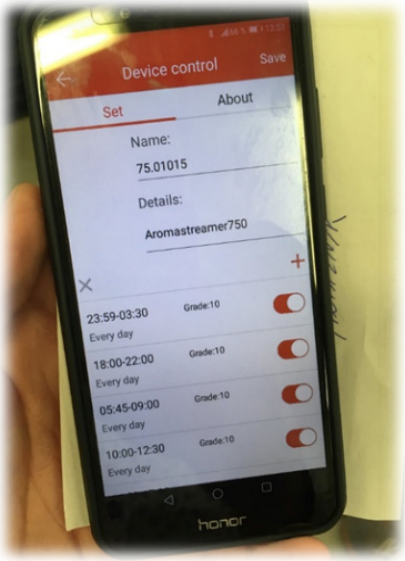

Figure 1.5 Bluetooth application
Source: Authors' own elaboration

The aromatization unit was continuously checked and replenished. After a month, the Energy aroma was replaced by the *Fresh Office* aroma (also after the recommendation of the aroma manufacturer and the results of laboratory tests), while the whole process proceeded in the same way as in the previous phase. Subsequently, air sampling was performed using airbags and an electric pump as in the first phase of the research. Through the so-called airbags (Figure 1.6) air sampling of the working space was performed, which was analysed in detail by gas chromatography.

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Figure 1.6 Special suitcase for sampling air bags
Source: Chromservis, 2019

The results of the research showed that the positive effects of aroma (*Aroma Energy*) with employee satisfaction are manifested mainly in night changes. This can be quite a useful finding, which has several practical implications. We can assume that if the aroma has a positive effect on the perception of the environment, then it may result in a better psychological setting of the individual, which may ultimately affect the performance characteristics of his work such as productivity, error, fatigue and the like.

We point out several important findings, the results of which will also help in the practical implications of the research. When working on night shifts, employee behaviour was most neutral. One of the assumptions of this finding is that during a night shift, employees are not as disruptive as other changes. Subsequently, it was found that employees are less happy about the night shift, which is logical and results from natural human behaviour. On the other hand, it turned out that their angry increases on the night shift, compared to other work shifts. Angry increased for employees, especially at a time when the aroma was not used on the premises. At the time when we deployed Aroma Energy in the production facilities, the employees were calmer. It can therefore be assumed that the positive effects of the aroma on employee satisfaction are shown mainly in the night changes. Before the research, the company's management also informed us about the fact that the productivity of employees on the night shift decreases. It can therefore be assumed that the aromatization of the workspace helps to solve this problem. This assumption, resp. the hypothesis needs to be verified by further experiments.

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1. 5 Conclusion

The working environment, including air quality, must meet strict standards. This also includes targeted aromatization of premises, which is known in practice and is used mainly in shops, relaxation and wellness centers, administrative premises, or even in households. As for the methods used for air quality research in the working environment, respectively. In general, questionnaire surveys are known in the in-door environment (Zainon et al., 2016; Roskams – Haynes, 2019; Maula et al., 2017) in non-production. But there are no known methods using technologies to collect neuromarketing data from human feelings without their knowledge and their statistical evaluation in the production environment. It was therefore a great challenge to explore the area of the impact of air quality in the work environment of the production sphere on the emotions of employees while expressing them through emoticons, which can be an inspiration for further development of the theory of neuroscience.

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2 USE OF SCENTS RELATED TO FOOD ENVIRONMENTS

2. 1 Why to use scents in food environments?

The objective of the present manuscript is to show the importance of using scents as a marketing tool for agri-food companies and how to evaluate the use of scents in consumer behavior. This topic has been recently reviewed by our research team and it is summarized in the present paper (Girona-Ruíz et al, 2021).

The smell/aroma is directly related to human emotions; it is the main trigger for human emotions after sight. In fact, it has been reported that 75% of human emotions are created through smell/aroma.

The olfactory bulb is part of the brain's limbic system (seat of emotions, desires and instincts), and that is why smells can trigger strong emotional reactions. This explains the strong link between smells, emotions and memories. In practice, it is possible to use this evidence to influence and promote certain feelings.

Smell is the second most used sense in marketing strategies in the food industry. Therefore, aromas play an important role in marketing strategies. The memory of smell is the most intense of all the senses, and only about 20% of olfactory sensations are forgotten. Human beings even maintain very old memories and feelings related to smell.

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Figure 2.1 Laboratory test of consumer evaluation of scents: assessment through questionnaires
Source: Authors´ own elaboration

Ambient scent is defined as a scent that is present in the environment but does not emanate from a particular object. These ambient scents have been classified based on:

i) the affective quality of the aroma (how pleasant the aroma is),
ii) the level of arousal of the aroma (how likely is it to elicit a physiological response), and,
iii) the intensity of the aroma (how strong it is).

There are three types of scents (Figure 2.1) used in environments named as:

a) **head**; head scents are generally small, light molecules that give the sensation of refresh and invigorate. These are typically fresh citrus or green notes, including lemon, lime, neroli, bergamot, grapefruit, and cooler herbal notes like lavender, thyme, and basil,

b) **heart**, molecules responsible for heart-like scents tend to be larger and can take anywhere from five minutes to an hour to develop. They can include different ingredients, such as flowers, spices, woods, resins, and grasses.

c) **basic**; basic-type scent molecules are the largest and heaviest. They are aromas such as woods, resins, oak moss, vanilla, amber and musk.

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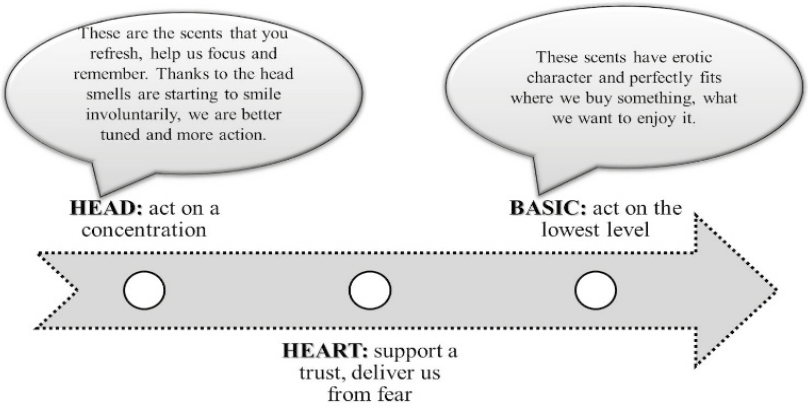

Figure 2.2 Types of scents
Source: Paluchová et al., 2017

Sensory marketing can be defined as marketing that involves the senses of consumers and studies the perception, emotion, learning, preference, choice, evaluation, knowledge, judgment and purchasing behavior based on the senses. Sensory marketing appeals to the senses with the aim of creating sensory experiences and converting them into specific emotions associated with a specific product.

Aroma marketing has two main modalities:

i) the use of the unique smell/aroma of the product itself, with the possibility of creating an aroma that identifies the company with the product/brand; and,

ii) the use of an ambient smell/aroma in spaces (restaurants, supermarkets, small shops, public spaces).

The expression "scent marketing" has been used to describe the use of essences to create an environment, promote products or position a brand, and therefore **scent marketing can be defined as the strategic use of the olfactory experience and essences in relation to commercial products.**

Scent sensory marketing is about much more than simply spreading a pleasant fragrance in a space. It may be, starting from the brand identity of a company (and its values) and studying its target consumer, to create an aroma that exemplifies company identity (and values).

In the 1970s, fragrances began to gain prominence as a tool for retailers aiming to improve the indoor environment by introducing specific scents.

Origins of Olfactory Marketing seems to be in the 1980's when British supermarkets realized that fresh baking bread aromas increased selling bread and other products. This moved them to introduce bakery as a

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new department area. However, the difficulty of introducing aromas in a supermarket for increasing sales can be illustrated by the fact that customers can smell fresh bread aromas and buy the bread but can prevent them from buying other goods. This reduction in their willingness to buy is because its sensory perception and emotions are, to some extent, satisfied by purchasing the bread.

Figure 2.3 Equipment for on store research to collect explicit consumer responses on scents delivered
Source: Authors´ own elaboration

That is a case based on the scent of a product itself. However, most recent studies have focused on ambient aroma, and analyzed the influence of aroma on the purchase intention of consumers.

In 1982, the Olfactory Research Fund coined the term "aromachology", relevant to marketing. This area of expertise deals with the temporary effects of fragrances on human behavior, feelings, well-being, moods, and emotions. **Aromachology, as defined by the Sense of Smell Institute in 1982, is the scientific discipline studying psychological and physiological effects of in-haling aromas and examining, feelings and emotions elicited by odors stimulating olfactory pathways.**

It has been said that stores that use ambient scents give their customers the feeling that they spend less time looking at products and trying them. Scents use has been evaluated for different purposes such as sensory marketing of different goods or services, and wellbeing and cosmetics, among others.

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Scent branding is quite popular in non-food stores, one may recall certain brand scents, but it is not that common in foods stores and restaurants.

Regarding our field of interest, foods and food related stores and environments, scents have been tested for several purposes: to study their impact on appetite, food consumption, food sales or evaluating shopping experience, among others.

Using scents in food environments can help to increase consumers satisfaction. Aromachology related to foods may have different applications; most active fields are sensory marketing and appetite modulation. Although, extensively used in no-food business, scent marketing would be also of great interests for food business, purposes such as brand identity or specific developments to suit needs to enhance consumer satisfaction would be of interest. Much more interesting would be the use of scents for modulating appetite, which will be an interesting tool to be included in anti-obesity strategies.

2. 2 Which data is to be collected when testing scents in food stores?

Classical data collection on consumer studies are questionnaires to consumers, many times under laboratory conditions (Figure 2.1). However, they cannot assess the complex set of factors affecting decision-making (emotions, feelings, etc.).

It is in this scenario that neuroscience tools entered the field of consumer marketing studies. Neuromarketing aims to use psychological and neuroscience tools to study subconscious processes during decision-making in order to provide scientific explanations of consumer's preferences and behaviors.

Main neuroscience tools used in neuromarketing are biometric measurements (body reaction measures: eye movements, facial expressions) and brain measurements. Using such techniques to measure respondents' subconscious reactions in addition to classical feed-back collection techniques may provide a comprehensive perspective on consumers' perception.

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Figure 2.4 Aromatization unit, air-sampling unit, equipment for data collection from explicit consumer responses
Source: Authors´ own elaboration

So, consumers' responses to food scents should be measured in two ways:

i) explicit tests: through direct consultation with consumers through surveys/questionnaires; and,
ii) implicit tests: using biometric parameter measurement equipment, for example using eye-trackers.

Data collection and research in food aromachology must follow empirical scientific methodology: goals, hypothesis, materials and methods (aroma, subject population number and representativity as well as control group), and proper statistical data analysis in order to get valuable conclusions.

Methodology for scent studies is in clear need of improvement by working in real conditions (Figures 2.3 and 2.4) and introducing neuroscience tools and real physiological measurements.

2. 3 Which have been the results of the studies run so far?

Very little information is available in the scientific literature regarding aromachology, and much less on aromachology related to food.

At present, focusing in the general scientific literature on aromachology, there are some scientific evidence reporting that inhaling

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aromas may elicit feelings such as relaxation, sensuality, happiness or exhilaration.

There are also scientific evidence on the physiological effect of scents. As an example, Shen, et al. (2005) – in a study on rats – presented evidence that scent of grapefruit oil, excited sympathetic nerves innervating white and brown adipose tissues and the adrenal gland, inhibiting the vagal nerve innervating the stomach, increasing lipolysis and heat production (energy consumption), and reducing appetite and body weight in rats; and, the opposite effect was observed for lavender, mainly due to linalool, that enhanced appetite and body weight.

A reduced number of scientific studies on aromachology related to food are available and most of them run in artificial laboratory conditions. The most common aim is food preference and choice followed by the study of the effects of odor on appetite; other interests are sales, shopping experience and the study on mechanisms connecting odor and emotions. Participants through questionnaires provide most of the data collected, with a scarce number of studies using neuroscience and physiological tools and measurements. Methodological procedures largely diverge among studies, making them very difficult to compare and extrapolate results.

The main results were:

- **The use of pleasant scents enhanced pleasantness**,
- **Unpleasant odors raised stronger emotions than pleasant ones**.
- **A pleasant aroma can affect the perception of the passage of time,** visual and taste perceptions and create a generally pleasant environment for clients
- **The use of ambient scents modified behavior**, especially the time spent at stores or viewing food images, slowing the flow of customers in the store and increasing the time spent in the store.
- **Scenting affected consumer choices**,
- **Scents, and so olfactory perceptions, interact with visual perceptions or imagery**. The effect of scents was enhanced by the congruency of the odor with the images, products, or even seasons.
- **Appetite was affected by odor exposure**, however, there are non-conclusive results. Some authors reported that the exposure to chocolate scent reduced the perceived hunger, also other pleasant scents (baby powder) reduced hunger perception. On the other side, some authors reported that exposure to food odors increases the appetite for congruent foods, including sweets, and those fresh scents reduced the crave for sweets. Other authors even concluded that the exposure to food odors may promote overeating and so contribute to obesity.
- **The use of scents increases sales.** Reported results have similarities with those reported in non-food stores.

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It seems that a relevant factor in the effects of scents is **the congruence between the products offered by an establishment and its aroma**: the more the congruent, the stronger the effect. Some authors have found that if the aroma was congruent with the product, the subjects:

- Spent more time processing the data,
- Generated more self-references, and
- Were more likely to make additional inferences and to exhibit a search behavior for other purchase options.

In general, cognitive elaboration was higher in congruent conditions.

As a general result, it can be said that **scents are used** in stores **to create a positive shopping environment** with the aim of increasing purchase intention or increasing the time spent in the establishment. All these factors are expected **to lead to an increase in sales and in the degree of customer satisfaction.** The reviewed literature points to a greater effect of scents when they are congruent with the food, to the fact that unpleasant scents raise stronger emotions than pleasant ones, to a clear effect of scents on food preference, as well as appetite mediated by the scent and the exposure time, as well as other effects on human behavior.

2. 4 What are the mechanisms behind responses to scents in food stores?

Regarding sensory marketing in food business, we have to differentiate among

- food stores (food is sold, not consumed)
- and restaurants (gastronomic facilities where food is consumed).

To this second situation, the concept neurogastronomy applies, neuroscientist Gordon M. Shephard (Berčík et al., 2021) first summarized the neuroscientific research on the gastronomic experience in the brain (perception and processing of taste, among others).

Taking all above mentioned into account, it can be said that there is a strong relation among sensory marketing, aromachology and neuroscience. These three applied sciences (sensory marketing, aromachology and neuroscience) are closely interrelated (Figure 2.5).

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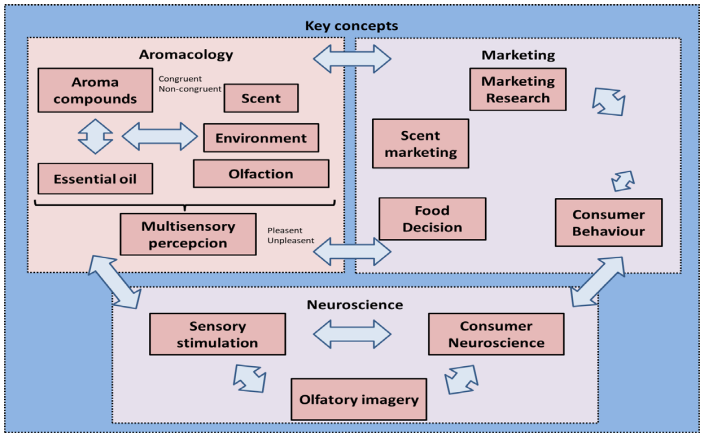

Figure 2.5 Key concepts relationship among aromachology, marketing and neuroscience in food stores
Source: Authors´ own elaboration

How scents affect food choice and perceptions? The two most commonly used explanations can be separated by:

- whether odor primarily influences unconscious effects, such as mood, or
- whether an odor primarily influences cognition.

It can be said that they affect human affective and cognitive dimensions.

Spangenberg et al. (2005) found that the affective dimension explained most of the effects that scent produced in people. In the area of commercial atmosphere, Mehrabian and Russell (1974) discussed mood as a mediating factor between environmental cues and behavior. Environmental psychologists claim that shoppers react to environmental cues with focus (desire to stay in the environment, explore, etc.) or avoidance behaviors (desire to leave) and that mood mediates this relationship. However, this does not seem to be clear according to the marketing literature,

Another explanation for the process is that smell influences **cognitive processes**. Morrin and Ratneshwar (2003) found no effect of scent on mood, but they found that scent increased attention to brands as measured by display times for various brands. Mitchell, Kahn and Knasko (1995) found that smell influenced the extent of information processing and cognitive elaborations.

However, it has to be concluded **that the most comprehensive theory has to admit complex psychological mechanisms mediating the effect of odors on mood, physiology and behavior.**

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In this sense, **mechanisms explaining the appetite for congruent foods have not been elucidated**. A theory has been proposed that cephalic phase responses mediated by the vagal nerve, that prepare the body for intake and digestion may be involved. However, it has been reported that the pleasantness of food odors (banana and savory meat) was reduced during odor exposure, whereas the specific appetite for the congruent food remained unchanged and hunger/general appetite was unaffected. This decreased odor pleasantness may be related to olfactory sensory specific satiety, SSS, (a concept presented by Rolls et al (1981) as **the decrease in pleasantness of, or desire to-eat recently consumed foods, relative to uneaten foods, which suggest a lack of appetite for the smelled food**. However, this does not match results obtained by other studies.

Ramaeckers et al. (2014) have coined the opposite term: sensory-specific-appetite, SSA, **pointing to an enhanced appetite for the congruent food, possibly explained by the fact that smelling the food anticipates food intake**, these authors hypothesize that the extended exposure to the odor stimulates chemical senses and reduces the appeal for the odor but not for the taste.

As a conclusion, it can be said that **different mechanisms would underlie both processed SSS and SSA**. So, we must admit that how odor affects humans is a complex mechanism.

Another factor that can be important for explaining this process is **time exposure to aromas.** It has been said that largest changes in food preferences may occur within the first minute to odor exposure. Several authors report that such effect depends on the exposure time to the scent:

- short times of exposure to sweet scents may enhance appetite for the food,
- long times decreases the appeal for sweet foods and enhances the appeal for healthy or other choices.

This may be caused by cross modal sensory compensation; scent provides reward enough and reduces the desire for consumption of indulgent foods, like an olfactory sensory-specific satiety.

Again, further research is needed, especially around behavior changes during first minute exposure to aromas.

Another factor to be considered is either the intensity of the scent is subthreshold or recognizable as different effects can be reported. There is not a clear conclusion on this aspect.

Finally, **most of the published studies only collected reported craving sensation or appeal, not truly food consumption**. So, it is necessary to clearly differentiate whether the studies report subjective measurements anticipating food intake (appetite, food choice) or actual food consumption (intake satiety)

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As a conclusion, **more studies are needed in reals situations and measuring actual consumed food to determine how the use of scents affects human behavior.**

2. 5 Future trends and needs on the use of scents related to food

Some questions must be addressed regarding the use of scents in food-related business:

- *Scents in sensory marketing: Copyright of a scent as food establishment identity.*

Transferring laboratory findings into products is neither an easy nor a quick process, and it is now starting to see the development of products and marketing campaigns that are properly incorporating scents into food establishments and/or experiences.

Should it be possible to copyright or trademark a scent? From the perspective of marketers, affirmative response will increase the scent marketing industry. Currently, only scents that are non-functional can be trademarked, and it is still not easy to get a scent trademark.

- *Employees exposure to scent.*

One relevant factor to consider when scenting is the opinion and wellbeing of employees. They are exposed to the scent the entire working session and they should be able to feel comfortable under such conditions. Air turnover needs also to be considered, as well as air quality and air flow.

- *Ethical issues*

Other points in need of attention are ethical issues, whether consumers agree with the use of food scents in food environments and if they had to be regulated to avoid the used of scents that may mask unwanted flavors or enhance the scent of low quality products.

- *Research effect of scents to suit specific needs: the example of food consumed in airplanes.*

Scents need to be congruent with the store location and not interfere with the scent of fresh food to avoid masking, confusing or generating off-flavors. All those considerations are taken into account by scent companies

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when developing applications for their customers. Scent branding is a well-established practice in airports and planes, but it requires careful consideration. While some may find aromas soothing, others find them intrusive, and some passenger may have an unpleasant flight experience.

Another question to be solved is airlines food service: Food consumed on airplanes does not taste as if consumed on land. Recent studies suggested that various factors such as low pressures, the decrease of the level of humidity and the noise perceived inside the plane maybe responsible for the decreased perception. Real causes are currently unknown and more studies are needed under real conditions for a better knowledge of the condition. Aromachology may be explored to provide solutions to overcome such decrease in taste perception.

- *Generating general accurate scales for scent in restaurants/food establishments: data collection procedures.*

It has already been pointed that methodology has to be improved and standardized, In this sense, data collection of data through questionnaires shows clear limitations under real conditions. Among others, one promising direction for future research would be to develop a general scale measuring the susceptibility of an individual to using scent as an input for decisions and evaluations. Efforts can be made to enhance the reliability of questionnaires.

However, collecting objective data (implicit tests) would be much more helpful and reliable. In this sense, the use of neuroscience tools and physiological measurements needs to gain place in the methodology applied to aromachology on food.

Also, the use of neuroscience tools and physiological measurements to gather human responses trying to avoid subjective data. This would benefit from the development of standard methodology and recommended experimental designs (number of participants, place, time, etc.)

Such observation points to the need of using implicit measurements (assessed by tools measuring body responses neuroscience and physiological related parameters) and other measurements such as sales of different goods (either related or unrelated to the scent).

Also, data collected from the stores should be compared not only between scented an unscented period, also with data collected from the same period from the previous years or similar establishments during the same period.

Air quality assessment during the studies will provide valuable information on the level of occupation of the establishment and proper

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ventilation conditions and health conditions for employees and customers (CO_2 concentration, particles in suspension, and volatiles in the air).

- *Research in real conditions.*

There is a clear need of running studies in real conditions (stores, restaurants, food business) with real food, as most of the available studies were run in artificial conditions. It has been pointed out that very few studies have been run in real store environments, and those studies had limitations: reduced number of participants, uneven participation during different phases, the fact that explicit measurements have also limitations (are they given by the most representative customers?; are they influenced by other factors such as noise?).

- *Scents use as appetite modulators.*

A relevant future need is the in deep research on scents use as appetite modulators (either to tackle malnutrition or obesity), which is not the main topic of this review but a matter of high interest for consumers. At present, the effect of odors is appetite/food intake is not clear and consistent among studies and may depend on exposure time to scents.

This field is in need of studies evaluating the effect of scent exposure during the first minute on real food intake, not just on appetite or preferences. Only when the real effect of scent on food intake will be determined scents may be potentially used in anti-obesity strategies.

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3 THE USE OF AROMA MARKETING IN RETAIL STORES

3. 1 The nature of aroma marketing in retail outlets

Smell is one of the most basic forms of communication among organisms, including humans. According to Kumar (2014), the sense of smell emotionally affects human beings up to 75% more than any other sense. It is particularly powerful as it does not require special brain involvement (Soars, 2009). The term “aromachology" was invented in 1982 to denote the science that is dedicated to the study of the relationship between psychology and aromas that elicit a variety of specific feelings and emotions – such as relaxation, exhilaration, and well-being – through scents stimulating olfactory pathways in the brain, especially the limbic system (Horská et al., 2018) Aroma marketing or scent marketing is a technique of influencing the recipient which aims to evoke a specific emotional state in the customer through the use of fragrance compositions. Aroma marketing can be defined as the art of using scents in a marketing campaign to connect with the customer’s emotions, being a significant element supporting modern marketing strategies and part of the marketing mix. It is an effective business tool and a powerful weapon in the fight to attract customers because the magic of scents is irresistible; one can close one’s eyes and plug one’s ears, but one cannot stop breathing (Pabian, 2011). In retail practice, aroma marketing is based on the aromatisation of commercial spaces or their parts. The main aim of these activities is to create a pleasant atmosphere in the retail space, which will be conducive to shopping (Tarczydło, 2012, pp. 110–111). An appropriately composed fragrance can be used for the following purposes (Andruszkiewicz, 2011, p. 257):

- creating a unique fragrance composition that will be the signature of a retail outlet (a single store or a retail chain), the so-called scent logo,
- enhancing the natural aroma of a product to stimulate interest in this product among customers,
- diffusing a scent in a store or a specific section of a store in order to increase the sales of products,
- emphasizing with a scent the unique features of a specific product on the shelf,

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- creating optimal conditions for the customer in the retail space.

Kimmel (2012) formulated the following guidelines for introducing aroma marketing in retail:

- fragrances should be tested in real conditions and feedback should be obtained before making a final decision,
- customers should not be overwhelmed with a specific scent,
- the brand scent should be as original as possible,
- scent marketing works best with a single fragrance, complex fragrances should be avoided,
- the fragrances used should offer a natural association with the range of products and relate to them,
- brand scents can work best when there already exists a specific association with a product and a particular fragrance in the customers' minds.

The most prominent examples of the use of scent marketing are the US fashion brands Abercrombie & Fitch and its subsidiary Hollister, which sell exclusive teen clothing. The individually created brand scent is used so intensely that passers-by can smell it as they walk down the street. The clothes in the stores also smell of this fragrance. In an experiment conducted inside a store, teenagers were able to immediately associate the brand's clothes with the company because of the brand scent. By combining loud music, appropriate lighting and a very intense fragrance, these retailers strive to attract the attention of young people as their target group and intentionally discourage older customers from visiting the stores. The fact that the companies use the same fragrance in all their stores around the world significantly enhances brand recognition.

Another example of the use of scent marketing comes from the company Nike. The corporation conducted an experiment in which the same pair of shoes was displayed in different showrooms, one of which had a floral scent. While the shoes had exactly the same characteristics, the study found that consumers were 84 percent more likely to buy the running shoes in the scented room, and the price of the pair of shoes was perceived to be about 10 US dollars lower than their actual price. The main goal of Nike scenting its shoe stores with a floral scent was to eliminate unpleasant smells, such as those of perspiration and plastic.

Still another example of the use of a fragrance in retail stores comes from Hong Kong. Oriental Watch, an Asian luxury watch seller, uses a specially created fragrance in its twelve Hong Kong stores. In the showrooms, customers can smell green tea as it is supposed to best reflect the Chinese brand's identity. The company's fragrance strategy is to encourage customers to spend more time in the stores as a result of a greater level of relaxation caused by the scent of green tea.

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The exclusive French fashion chain Kooples diffuses fragrances in their stores to increase their popularity and the time spent by customers in the stores. Their fragrance, called "66", emphasizes the elegance and modernism of the brand as well as the fact that the clothing in this store is fashionable. Wormland, a menswear fashion chain, also uses its own scent that identifies all the chain's stores throughout Germany. The composition of the fragrance evokes associations with men's fashion, with notes of wood, bergamot, lavender, anise and nutmeg. The aim of the fashion company is to strengthen brand recognition (Bayer, 2021, p. 33).

Media Markt, a leading electronics retailer in Europe, also aims to create an emotional shopping experience through the use of fragrance. The company focuses on enhancing the brand experience and building a strong emotional relationship with customers. After six weeks of scenting its stores, Media Markt recorded a sales increase of approximately 40%.

The Korean electronics company Samsung diffuses its signature fragrance "Intimate Blue" in its flagship stores. The scent, with its crisp and stimulating notes, was designed to reinforce the value of high quality and emphasize the uniqueness of the Samsung brand.

A scent approach is also used in the original Weber store in Berlin which sells items related to grilling. The barbecue department has been made more tangible to all the senses through multisensory marketing. The store is scented with a special barbecue aroma to enhance the overall ambience and match it with appropriate grilling sounds. The scent is supposed to appeal to the customer's emotions and inspire their enjoyment of the grilling experience (Bayer, 2021, p. 34).

Another example of aroma marketing in retail comes from the Alma delicatessen chain in Poland, which used a cinnamon fragrance in a campaign promoting Bols Cinnamon vodka. The aroma of fresh cinnamon was supposed to attract the attention of consumers and for the fragrance to be retained in their memory for a long time. Bols decided to take such a step after analysing the results of research on aroma marketing. The findings show that a properly selected fragrance helps to create the ambience of a retail outlet; and when applied to an individual product it helps it to be distinguished on the shelf, strengthens customers' associations with it, and makes them remember the product. This was intended to be the goal of the fresh scent of pure cinnamon, corresponding to the Bols Cinnamon bouquet, which was dispersed using natural diffusion and could be smelt from a distance of a few meters. As a result of the use of aroma marketing, the sales of Bols vodka increased (Deluga, 2012, p. 32).

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3. 2 Advantages of aroma marketing in retailing

At the current stage of development, it is difficult to say whether scent marketing directly influences customers to make a purchasing decision. However, it can encourage customers to spend more time in a retail outlet, repeatedly visit a store, emotionally connect with a brand and take a closer look at the products on the shelves. In other words, aroma marketing can bring the following benefits (Goris – Hutter, 2011, p. 39):

- **Creating a pleasant atmosphere by improving indoor air quality.** In some cases, it is also used to eliminate unpleasant odours. A 2011 Gorris and Hutter study found that customers consider scented retail premises to be 30 percent cleaner and also rate them better (Goris – Hutter, 2011). A pleasant smell has a stimulating effect on people, whereas a bad smell acts as a warning (Goris – Hutter, 2011). Unpleasant odours in stores have a stronger influence on customers than pleasant olfactory sensations. A study by Nölke and Gierke from 2011 showed that stale air, excessive scenting and sewage odours have a strong negative impact on customers, who are likely to spend less time in the store (Nölke – Gierke, 2011). The above-mentioned study by Gorris and Hutter also analysed the influence of various pleasant smells. Lavender, for example, can be a calming and stress-relieving fragrance. Citrus scents improve concentration, and herbal scents have a disinfecting effect (Goris – Hutter, 2011). Floral fragrances, in turn, encourage customers to spend more time in the store (Karr, 2018). Certain types of fragrances can also influence the customers' perception of the quality of the goods offered (Mathawan, 2020). For example, the scent of leather creates an impression of wealth and is therefore often used in high-end stores (Karr, 2018). The same applies to cardamom, as the smell of incense is often considered luxurious. On the other hand, cosmetic brands tend to use clean and fresh fragrances (Mathawan, 2020). Research shows that more than half of customers are willing to spend more money in a pleasantly smelling store (Karr, 2018).
- **Increasing customer attention.** Smells can also be connected with associations developed in the past. For example, the use of a cinnamon fragrance evokes fond memories of Christmas in many people. In this way, fragrances can connect brands with memories. The goal is to use new fragrance creations in places where people associate positive emotions with individual brands (Goris – Hutter, 2011).
- **Creating a positive shopping experience.** In-store shopping experiences are becoming more and more important (Roschk – Hosseinpour, 2019). When the customers' senses are stimulated, their perception of a given retailer is likely to improve (Badersbach, 2014).
- **Building trust and a sense of well-being.** For many people, entering a store or supermarket is a stressful situation because of the unfamiliarity

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of the surroundings and the overwhelming abundance of goods on offer. The use of the right fragrance in the right amount can reduce the level of stress in customers (Goris – Hutter, 2011). It can help create a sense of comfort in the environment, without any inhibitions or fears (Goris – Hutter, 2011). If the customers additionally associate the fragrance with a pleasant memory, they are less anxious and therefore may buy more (Goris – Hutter, 2011).

- **Extending the time spent by customers in the store.** Fragrances evoke an emotional first impression of a brand and have a motivating effect that keeps people in stores (Mathawan, 2020). Thus, customers spend more time in the shop. Research shows that a pleasant smell increases the time people spend in the store by 16%, which increases revenues by 6 to 15%, depending on the sector (Goris – Hutter, 2011). In fact, 82% of customers are likely to stay longer in pleasantly smelling retail establishments (Mathawan, 2020).
- **Increasing the customers' willingness to buy and thus increasing sales.** Various studies show the influence of ambient smells on the willingness to buy products. For example, a Nike study found that scenting their store increased the desire to buy by 80 percent. Diffusing the aroma of coffee around a petrol station with a mini-market increased coffee purchases by around 300% (Karr, 2018). A 2010 study by Schmitz shows that ambient scents increase the consumers' willingness to buy goods by about 14%. Scenting also increases the tendency for impulse purchases, which consequently translates into an increase in sales (Schmitz, 2010). A bakery that diffused the scent of freshly baked bread into the street saw an increase in customer numbers and a 30% increase in their sales revenue (Häusel, 2016).
- **Gaining a competitive advantage.** Brand or company recognition can be enhanced through the proper use of fragrances. This is because the company gets the opportunity to stand out from its competitors and communicate its corporate identity not only through audio and visual effects, but also at the olfactory level, which results in an increase in brand recognition and customer loyalty (Goris – Hutter, 2011).

3. 3 How to use aromas in a retail store?

The implementation of aroma marketing in retail can make use of various technologies. Aromas can be dispersed using dry or cold-air diffusion. In the case of the former, the fragrance is delivered from a dispenser that contains material soaked in fragrance oil. In the case of the latter, fragrance oil under high pressure is diffused directly into the air or into the ventilation system. The devices differ depending on whether they are used to create fragrance islands or an ambient climate throughout the retail premises. In

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the case of new retail establishments, scenting should be considered at the planning stage as a supplement to ventilation or air conditioning systems. In completed and already in-use buildings, local scenting can be used, i.e. fragrance islands. One of the most popular technologies for the implementation of fragrance marketing is what is called cold-air diffusion. Devices based on cold diffusion are currently the most technologically advanced solutions available in the world. Cold-air diffusion consists in transforming fragrance oils into a micro-mist of 0.2 to 1 micrometre particles. This micro-mist easily combines with air molecules and spreads over large areas and takes 12–14 hours to drop by 1 meter under vacuum conditions. As a result, the fragrance remains in the air for a long time. This is the best technology for scenting large areas. Several models of devices that use the principle of cold-air diffusion are available on the market and an appropriate model can be selected depending on customer requirements, the type of premises, the possibilities for locating the device and connecting it to the ventilation system or air conditioning. Cold-air diffusion technology is the only one that allows the fragrance to remain at the same intensity level from the first day up to the last day before the cartridge is replaced. This is the fundamental and most important factor that distinguishes cold-air diffusion from airflow technologies, in which whether it is a saturated cartridge or a liquid with strips immersed in it, there will be a gradual decrease in efficiency. The unquestionable advantage of this technology is providing steady fragrance intensity, which means that the user is guaranteed that the device in which they have invested will always provide the same benefits and fully fulfil its role. Airflow technology consists in enclosing the fragrance composition in a solid, natural carrier. The scent is not heated in any way, which makes this method safe to use. This technology enables the effective dispersal of a fragrance without the need for any complicated devices, which makes the scenting process very economical and efficient. Perfectly controlled evaporation makes it possible to maintain a constant level of fragrance throughout the life of the cartridge. Airflow devices are best suited for small and medium-sized shops. Airflow devices which control the direction of the scent are also often used. They appear as stand-alone devices or to supplement cold-air diffusion technology (Deluga, 2012, pp. 32–36).

3. 4 Conducting experiments on aroma effects in a retail store

3. 4. 1 Experiments – methodological fundamentals

Experiments are frequently used to look for regularities in the behaviour of buyers. An experiment is defined as "a repetitive procedure involving a

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planned change by the researcher of certain factors in the analysed situation, with the simultaneous control of other factors, undertaken in order to obtain, through observation, an answer to the question about the effects of this change" (Sułek, 1990, p. 181). This definition indicates that the necessary components of each experimental procedure include the following (Rubacha, 2008, p. 45):

- Independent variable: a variable that affects other variables and is treated as the cause of a specific effect
- Dependent variable: a variable influenced by other variables. It is the result of these influences; hence its final value cannot be predicted by the researcher.

The main aim of an experiment is to prove (measure) the influence of the independent variable on the dependent variable. Hence, the independent variable is referred to as what is called the experimental stimulus (Babbie, 2003). This can sometimes occur on different (two or more) levels (Strelau, 2006). Obviously, both the dependent and independent variables must be clearly defined before the start of the experiment.

In order to demonstrate a cause and effect relationship between the independent and dependent variables, two (experimental) situations must be created which will differ in only one element, namely the impact of the independent variable. Thus, an experiment is carried out on two groups of participants: the control group (stimulus absent) and the experimental group (stimulus present). If the level of the dependent variable is found to differ between these groups, it can be assumed that this difference is a result of the independent variable.

There are two basic types of experiments: laboratory experiments (also referred to as artificial) and field experiments (defined as natural) (Kaczmarczyk, 2003). The former types are experiments carried out in specially designed rooms, i.e. laboratories. This makes it possible to flexibly create specific test conditions that do not exist naturally, but only mimic real situations. Importantly, in these types of experiment the conditions can be controlled so the influence of confounding variables on the results of the experiments can be minimized. Additionally, the laboratory environment allows one or more elements to be manipulated while the others are left unchanged (Bryman, 2008). A certain drawback of these types of experiment is that it involves the creation of unreal, non-authentic situations by creating certain engineered and isolated ideal states (Motycka, 1998). On the other hand, it is not the purpose of laboratory experiments to ensure their consistency with real-life conditions. Certain artificialities in the situations in which the tests are carried out in the laboratory may help to isolate specific variables between which the cause-effect relationship is sought.

The second types, known as field experiments, are experiments conducted under natural conditions. On the one hand, this eliminates the

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problem of ensuring the realism of the experimental situation. On the other hand, it is difficult (and sometimes impossible) to influence the conditions under which the experiments take place. This makes it difficult to clearly and unequivocally demonstrate a cause-effect relationship (Bryman, 2008).

Comparing the two types of experiments, it can be concluded that laboratory experiments provide the possibility of controlling practically all the aspects of the conditions under which they are being carried out. On the other hand, however, the artificial research environment created as part of these types of experiments adversely affects the possibility of generalizing the results. The opposite situation can be observed in the case of field experiments. Conducting them in a natural setting offers a much greater chance of ensuring high external validity. On the other hand, in these types of experiments the possibility of shaping the conditions under which the research is carried out is very limited.

3. 4. 2 Field experiment carried out in a grocery store

As part of the Erasmus+ Strategic Partnerships project entitled "NEUROSMARTOLOGY", an experiment was conducted to assess the impact of ambient fragrances on the behaviour of customers inside a store. In particular, the aim was to determine the influence of the aroma of chocolate on the customers' assessment of the confectionery department and on the sales of chocolate products.

Two research questions were asked:

- What will be the impact of the aroma of chocolate on the assessment of the confectionery department (increase/decrease) in relation to the absence of this stimulus?
- What will be the impact of the aroma of chocolate on the sales of chocolate (increase/decrease) in relation to the absence of this stimulus?

In order to make the research as realistic as possible and increase the credibility of the obtained results, it was decided to conduct a field experiment. Thus, the study was conducted in a supermarket belonging to a global grocery chain.

The following variables were defined for the experiment:

- The independent variable was a chocolate aroma stimulus. The manufacturer describes this aroma as "a sweet temptation, fascinating by the typical character of unskimmed milk". The stimulus was delivered by means of an AromaSteamer 750 scent diffuser, which diffuses fragrances using cold-air diffusion

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technology. The scenting intensity was set at level 4 on a 20-level scale. The diffuser was placed in the section with chocolates and sweets containing chocolate (chocolate biscuits). Thus, a chocolate fragrance island was created in this supermarket section.

- Two dependent variables were defined in the experiment:
  - One dependent variable was the subjective feelings of shoppers about the atmosphere in the confectionery department. The necessary data was collected using a monitor with a touch screen placed on a stand (kiosk). The question displayed on the screen was "How do you rate the atmosphere in the sweets department today?" Answers were provided by selecting one of the four graphic symbols indicating the level of satisfaction. Like the aroma diffuser, the monitor was also placed in the confectionery section.
  - The second dependent variable was the sales of chocolate as well as sweets with chocolate. The data was obtained from the store owner in the form of sales reports.

The organization of the area in which the experiment was conducted, the appearance of the kiosk, and the fragrance-diffusing unit are shown in Figures 3.1–3.3.

Figure 3.1 Experimental settings
Source: Authors´ own elaboration

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Figure 3.2 Kiosk
Source: Authors´ own elaboration

Figure 3.3 Fragrance-diffusing unit – Aroma Steamer 750
Authors´ own elaboration

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In order to be able to demonstrate a cause and effect relationship between the diffused aroma of chocolate (independent variable) and the assessment of the atmosphere and the sales of chocolate (independent variables), two experimental situations were created:

- a situation under the impact of the stimulus (experimental group): the chocolate aroma was diffused in the store for 30 days between 9 a.m. and 8.30 p.m.
- a situation without the impact of the stimulus (control group): no chocolate aroma was diffused for the next 30 days.

Experiments in which complex and technologically advanced research equipment is used may be exposed to the occurrence of so-called instrumentation. Instrumentation describes any changes to the measurement tools that might occur during the course of the experiment. These include, among others, mechanical defects or software defects that require the termination of the experiment. Sometimes it may be necessary to repair the apparatus or replace it with a new one. This may lead to a situation in which some participants will be tested with one model of the apparatus and some with another. Then the difference in the final measurements may be the result of the use of different equipment and not the influence of the stimulus. Fortunately, no such issues were encountered in the described experiment.

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4 USE OF SCENTS RELATED TO RETAILING AND SERVICE SECTOR

4. 1 Why just aromas and smell?

The sense of smell is the most sensitive sense of the human body. It influences up to 75% of human emotions. The human brain remembers up to 35% of information through this sense. The sense of smell is much more important than it might seem at first sight. How it influences customer behaviour and purchasing decisions is being addressed by a relatively young scientific discipline, one of the existing types of sensory marketing – aroma marketing, also known as aromachology. Aroma marketing is starting to have its importance today – at a time when marketers are confronted with the problem of visual repletion. This is causing consumers to become increasingly immune to traditional marketing activities and thus register them in a state of so-called perceptual blindness. Given this fact, it is increasingly difficult to attract the customer at the point of sale, which is the last thing that can reverse a person's decision to buy a product. And so marketers are increasingly trying to attack multiple senses simultaneously. One of the most important is the sense of smell. Surveys using artificial intelligence (AI) have revealed that the sense of smell is, in terms of targeting customer senses, of the highest importance. If you walk into the store that has heavy, stuffy air or an unpleasant smell, you'll just leave. The store has lost the customer and other sensory factors, such as lighting and sound, or noisiness of the environment, are no longer relevant to deal with. The importance of using the sense of smell is confirmed by the fact that while all other sensory systems represent a long pathway of information transmission to the brain, the sense of smell is directly linked to the brain centres responsible for emotion and memory. This also means, for example, that we retain olfactory memories much longer than visual ones. The purpose of aroma marketing is to evoke the desired emotional response and positive association – whether with a brand or a specific product – on a subconscious level through properly chosen aromas. And it has to be said that this succeeds much more with women than with men. It is scientifically proven that women detect smells more easily than men and also have more intense brain responses to aromas or odours. This is probably why we see them much more often in perfumeries.

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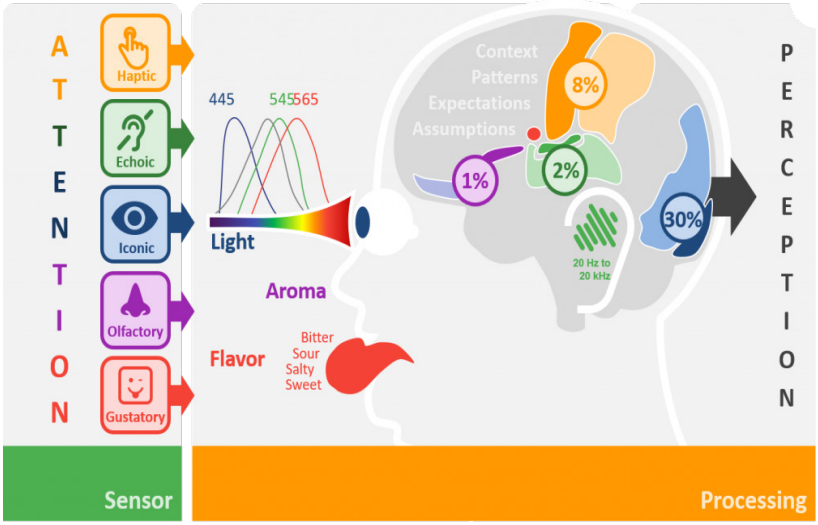

Figure 4.1 Processing of sensory stimuli
Source: Learning Evangelist, 2018

4. 2 What can aromas do?

The presence of deployed aromatisation in the trade and service sector can have a diverse positive impact. In this context, an INCREASED LENGTH OF STAY in a given aromatized space was observed by 15.9% due to the impact of aromatization. The use of aromas in a boutique, shoe store or other clothing store can attract customers. With a good scent, customers stay longer, shop longer and are more relaxed. It is proven that aromas INCREASED CUSTOMER INTENTION TO BUY for about 14.8% and 6.0% HIGHER TURNOVER was also observed.

As an example, we can also cite the Austrian post office network, which has decided to use aromatization as part of its olfactory identity, i.e. that customers will see the brand but also will smell it. They therefore had their own type of aroma made. It was called Lorenzo Dante Ferro. Its development cost about €1500, with the requirement that this aroma should contain a neutralising ingredient just for the socially disadvantaged groups who go to these places to get unemployment benefits. The pilot testing of these aromas also had the side effect of a 12% increase in the turnover of consumer stationery in the post office places. It should be pointed out that a call system is placed in each branch and waiting customers are able to shop.

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Examples of the impact of selected aromatized companies:

Ferrero company:
It used the scent of chocolate for aromatization, after which it registered a 90% increase in turnover.
Frazer company:
For aromatization, it used the Coffee & Cake aroma. The company experienced a 49% increase in baking sales.

HEM company:
It used the Coffeehouse aroma for aromatization. The result was a 30% increase in turnover, while the sale of sweets increased by 18% and tobacco by 12%.

Shell gas station:
For aromatization, they used the Coffee & Cake aroma, the impact of which increased sales by 30%.

Selgros cash & carry company:
For aromatization was used the scent of Brazil Orange. As a result, sales increased by 110%.

Spaces aromatizing with a light, pleasant and suitable aroma contributes to:

- ✓ positive customer behaviour;
- ✓ prolongs the stay of customers in the sales area because it smells nice;
- ✓ increases the willingness to buy;
- ✓ encourages increased customer and visitor attention;
- ✓ provides customers with a new shopping experience;
- ✓ motivates employees and improves the working atmosphere;
- ✓ increases productivity and creativity;
- ✓ reduces negative odours and improves air quality;
- ✓ creates a competitive advantage;
- ✓ last but not least, increases turnover.

4. 3 Examples of the use of aromatisation in services

A lot of studies have been conducted and focused on the impact of aromatization in different service segments. Several examples can be cited, most of which directly confirm the positive impact of aromatization on the customer and, ultimately, on the operation itself.

Aromatization of restaurants and cafés is very popular. For this service segment, the most commonly used aromas are those related to the

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dominant product offered. Thus, these are mostly food scents. Aroma marketing in such facilities, with a suitably chosen aroma, can not only promote sales by creating a pleasant atmosphere and increasing the appetite, but also plays an important role in the direction of odour neutralisation.

Among such research we can mention, for example, the research conducted in Slovakia, which focused on the impact of deployed aromatization in the restaurant SportPub in Brezno and the impact of aroma on consumer preferences in the sale of baked baguettes – Panini. Two aromas – "Chicken soup" and "Crunchy bread" – were deployed in the space of the service. The results of the comparison of sales in the period before and during aromatization showed that more Panini were sold during aromatization (Berčík et al., 2016).

Another research conducted in Slovakia, also using innovative neuroscience technologies, namely the FaceReader device, examined aromatization in the Sport Café in Nitra. The research consisted of testing under laboratory conditions, where a group of respondents – customers of the café - selected a suitable aroma based on conscious and unconscious feedback. This was the Coffee House aroma, which was then deployed in the café. The results of the testing confirmed the assumption of a positive impact of aromatization that increased coffee sales. This was an increase of approximately 30% in the tested period (Berčík et al., 2020).

We can also mention the research carried out in a pizzeria in Brittany, France. Two different aromas, lavender and lemon, were diffused in different places in the restaurant environment. The sales results from the aromatization period showed that the lavender aroma increased the customers' length of stay and the amount of food they ordered. The lavender had a relaxing effect on people and they stayed longer in the aromatized space. In a nice relaxing atmosphere, they ordered more items and increased the final amount spent. However, in the case of lemon aroma, such an impact and increased sales were not proven (Guéguen – Petr, 2006), which points to the importance of choosing the right aroma for aromatization, because if the aroma and its intensity are not chosen properly such aromatization not only may not have a positive effect, but ultimately the effect may be the opposite.

We will also mention the research that was conducted at the Brooklyn food market NetCost, where aromatization with delicious scents was deployed in various aisles of the market. After matching the scents with different sections and items sold, such as rosemary near freshly baked bread, etc., there was an increase in sales of at least 7%. Since a well-chosen scent increases appetite beyond the normal human limits, customers were more likely to spend more money for the offered products (Pulido, 2019).

Aroma marketing is today increasingly used also by accommodation establishments. It has its particular importance in hotel chains, which have their own aroma mixed as their own aroma logo, which then becomes an

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inherent part of their brand and customers can easily identify such hotels all over the world without the involvement of other senses.

For example, the Hard Rock hotel chain uses aromatization to attract new customers and keep them coming back. For example, the Hard Rock Hotel in Orlando uses the smell of candy and donuts to attract people to its ice cream shop. Their sales have increased by 45% as a result. The scents are deployed by the hotel at a higher intensity, which some customers find uncomfortable or even annoying, but most customers love the smell of their places and based on this fact, they also like to return to these hotels (Smell Inc, 2011).

Another example is the Omno Hotels and Resorts chain. This company started scenting its places with the scent of green tea and lemongrass already in 2006. This fragrance is still their signature scent. In their cafés, for example, they use the scent of cappuccino and mochaccino. In past guests of these hotels received papers scented with the aroma of blueberry muffins, which should have made them want to buy these muffins in the hotel lobby (Krishna, 2010; Ambius, 2016).

For example, the aromatization of medical facilities is also of great importance. Visiting such facilities is usually associated with long waiting times, feelings of uncertainty, fear and nervousness, and these negative feelings are intensified by the smell of disinfectants and other odours. Therefore, odour management is of particular importance here. For example, the balanced smell of fruit or the scent of camomile or lavender can reduce fear and nervousness in visitors and help to create a pleasant relaxing atmosphere as well as increase confidence in the service. Suitable scents for retirement homes, for example, are the fresh scents of lemon and tangerine or the clean air scent that evokes cleanliness. For pharmacies, for example, scents such as grapefruit, lemon, orange or tangerine are suitable, i.e. scents of vitamins (more on Aroma Marketing, 2020).

Various studies have also been carried out in this segment. For instance, at Vanderbilt University Medical Center in Tennessee, a scent in the emergency room was deployed in 2010. According to those involved, the aroma helps doctors and nurses feel calmer, improves mood, and minimizes unpleasant odors. In selecting an appropriate aroma, they tested essential oils that would help reduce stress and increase energy. The dominant scents were: eucalyptus, which suppresses odor and has antibacterial characteristics; citrus scents, which are uplifting and can help relieve anxiety (more on Air-Scent, 2020).

Vanilla has been further deployed in MRI machines, for example. As the results showed, it helped reduce claustrophobia and tension. A hospital in Florida saw a significant drop in the number of people requiring sedation, as well as a 50% drop in the number of cancelled appointments.

Calming scents relieve patient stress caused by many factors, including anxiety before surgical procedures. North Shore Medical Center

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in North Miami and the University of Miami Lennar Foundation Medical Center have also begun to aromatize. The former center has scented its main lobby and the second has focused on the central waiting area, administrative offices, and other locations (Air-Scent, 2020), again with demonstrably positive results.

For the entertainment industry, aroma marketing also has its irreplaceable importance. Customers have an enhanced and more authentic experience of attractions thanks to aroma, because they no longer just see and hear, but also smell.

For example, we can mention a study carried out in one of the casinos in Las Vegas, where they deployed a floral scent to subconsciously make their visitors feel more comfortable and prolong their time in the casino. The results showed that over the one weekend, the casino registered a 49% increase in sales in the scented section, while profits in the non-scented sections remained unchanged.

Cinemas are also starting to be frequently aromatized. In addition to the smell of popcorn, people also associate them with the smell of cola. These are the strongest aromas used in the area. But aroma marketing here can also increase sales of complementary items outside of the actual menu and snacks. An example is the aroma campaign of NIVEA brand. During the commercial, in which a recording of a typical summer holiday at the beach, with people lying on sun loungers and sea waves, was played to cinema space, the typical scent of a sunscreen was also diffused into the cinema room. At the end of the spot, there was a slogan: "NIVEA. The smell of summer." The result of this study showed an increased interest in the company's products by up to 515% compared to a study with the same spot but without the use of aroma (Aroma Marketing, 2020).

We can also mention the segment of fitness centres, gyms, wellness and spa. Until recently, smell was underestimated in this segment of services. However, different scents can motivate, relax or help motivate. Aromas also play an important role in suppressing unwanted odours. In all of these areas, it is important to apply healthy and clean scents with essential oils that improve the environment and destroy viruses, bacteria and mould. Wellness and spas focus on scents that soothe and relax, such as eucalyptus, lavender, marjoram or tangerine (Air-Scent, 2017; EuroSpa, 2018). A suitable and popular scent is mint, which energises and revitalises. Strawberry and buttered popcorn, in turn, can help burn more calories in the same amount of time. Banana, green apple, and mint scents can lead people to reduce their appetite (Air Esscentials, 2020).

First impression is very important in any service or business segment. And so it is with institutions dealing with clients' finances. In these institutions, a pleasant aroma on entry can instill a higher level of trust in the services and company. It is very important to choose an appropriate scent that is gentle and natural. In such institutions, these are the aromas

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that have a calming effect on the clients. Financial institutions also tend to use the smell of leather and tobacco, which evokes a feeling of luxury and trust. Rosemary and mint are also popular scents, which increase sharpness and improve concentration, which is necessary for dealing with financial matters (more Aroma Marketing, 2020).

Research results show that those banks that aromatize their spaces have increased their revenues and also the number of newly opened accounts. As an example, we can mention the National Australia Bank in Melbourne which was one of the first banks to use aromatization in its places. Specifically, it has used the scent of lime and grapefruit to improve the overall experience of its customers.

Also, Ocean Bank in Florida has created a premium scent for its branches, namely a mixture of tangerine, fresh ozone and notes of green cardamom, backed by black pepper and musk. Aroma marketing is used by this bank not only to scent the spaces, but also in the form of scented covers, checkbooks, and pens (Air-Scent, 2019).

The signature scent for Helm's Bank, L'essence contains notes of chocolate. It was developed as part of the brand's complete olfactory strategy. Reports show that specific Helm's branches that have implemented this signature scent, plus updated their logos, colors and sonic branding, have actually doubled their revenue and the number of new accounts. Customer satisfaction rates increased from 20% to 99% (Air-Scent, 2019).

This is just a fraction of the research that has been conducted and just a fraction of the service industries. Aroma marketing has its place, of course, in many other segments such as travel agencies and transport companies (airlines seem to be the most used so far), telecommunication companies, the IT segment and others. Practically, we do not find an sector in which aroma marketing does not have its place today and cannot be used to achieve positive results.

4. 4 How to choose the best aroma?

There are several ways to test the effect of aromas, depending on the substance. The most common is to investigate olfactory sensitivity, but also the influence of aromas on human behaviour and perception.

As the influence of aromas is mainly subconscious, it is essential to involve tools that can detect subconscious influence. In many cases, this cannot be captured in a traditional way, e.g. through a questionnaire. The olfactometer device is very often used, which allows a subjective assessment of the pleasantness or unpleasantness of the odour sensation.

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Figure 4.2 Olfactometry in laboratory conditions
Source: Odournet, 2020

The subconscious measurement can be performed using a device that monitors electrical brain activity – an electroencephalograph. This is the same device as used in healthcare but in a mobile version. A less complicated device is the monitoring of facial expressions and pupil dilation. The recorded video of the face is then analysed by special software called Facereader.

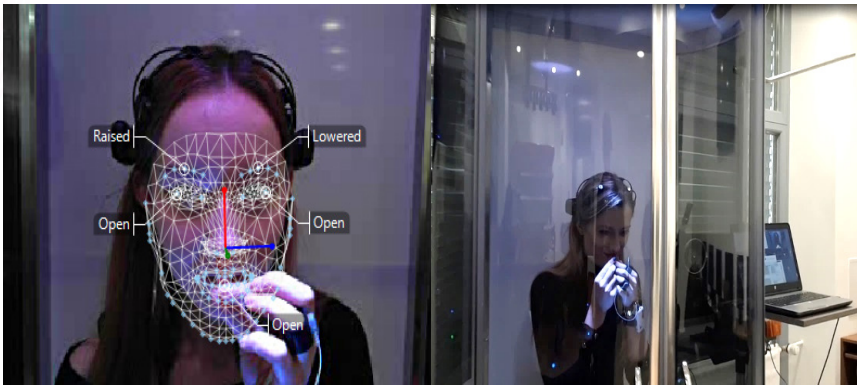

Figure 4.3 The use of facial biometrics and electroencephalography in aroma testing under laboratory conditions
Source: Authors´ own elaboration, 2021

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4. 5 The influence of scent on consumer behaviour in the sweets department of a retail grocery store

Many research and studies carried out around the world indicate the influence of aromas on people in the form of changes in moods, preferences and emotions. However, there is a lack of research focusing on selecting the right type of aroma and intensity for a specific area so that the resulting effect, in terms of engagement, pleasant associations and product purchase decisions, is maximised. Investigating the impact of aroma compounds only through classical forms of market research does not reflect relevant information due to the fact that aromas have a primary impact on the subconscious mind, which cannot be evaluated on the basis of declarative statements alone.

We decided to conduct research that demonstrates the influence of selected aromas on people's emotions and preferences when choosing a particular type of goods. In order to be able to select a narrower range of aromas suitable for the sweets department from the portfolio of available and suitable aroma compounds, we implemented an association test.

Using an online association test with 130 respondents (representation by gender is shown in Table 1 and by age in Table 2) and via GroupSolver, we identified the word associations that respondents most closely related to the sweets department and to which we subsequently matched the available aroma compounds.

Table 1 Representation of the sample in the word association test by gender

Gender	Absolute abundance	Relative abundance
Male	29	45,00%
Female	72	55,00%
Sum	**130**	**100,00%**

Source: Authors´ own elaboration, 2020

Table 2 Representation of the sample in the word association test by age

Age	Absolute abundance	Relative abundance
18–24 years	62	48,00%
25–49 years	36	28,00%
50–64 years	22	17,00%
65 and more years	10	7,00%
Sum	**130**	**100,00%**

Source: Authors´ own elaboration, 2020

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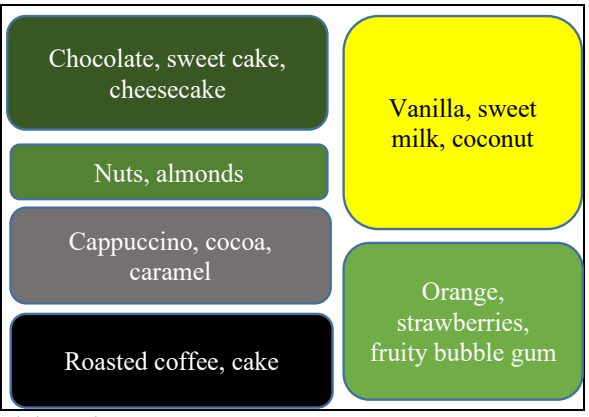
Table 3 shows the respondents' answers to the question "What do you most associate with the smell of the sweet department?" Based on their answers and in cooperation with the German company REIMA AirConcept GmbH, the available aromas were profiled to match the association preferences of the respondents. They mostly associate the smell of the sweet department with the sweet smell of chocolate, nougat, different types of coffee, vanilla, but often also with the fruity smell of orange. Based on the above, we decided to conduct an association test using facial biometrics and based on the results to conduct an experiment in the laboratory.

Table 3 Initial selection of aromas for biometric association test using GroupSolver®

	TOP 5
1	**Chocolate**
2	**Nougat**
3	**Cappuccino**
	Coffee
4	**Vanilla**
5	**Orange**



Source: Authors´ own elaboration, 2020

After gaining initial knowledge and based on interviews with representatives of companies dealing with aromatization, we proceeded to an international association test. This was not to test specific flavourings, but only associations that are linked to the sweets sales department. Unconscious feedback was monitored through a special platform that allowed remote tracking of facial expressions. This test was linguistically adapted and conducted in each partner country. The subject of the testing was also to determine the suitability of 6 aromas for the sweets department.

In the second stage, 6 aromas (vanilla, chocolate, nougat, coffee, cappuccino, orange) were profiled to represent the base of selection for the sweets department in the biometric test. A comparative study was conducted in six European countries (Slovakia, Czech Republic, Poland, Germany, Denmark and Spain) on a total sample of 521 respondents.

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Figure 4.4 Sweets sales department
Source: Authors´ own elaboration, 2021

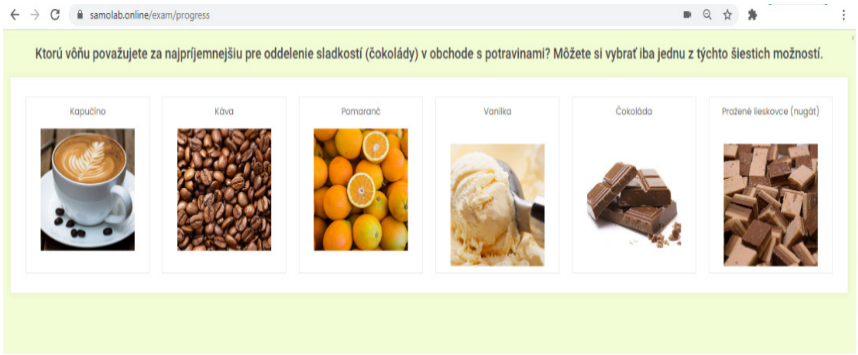

Figure 4.5 Implicit association test
Source: Authors´ own elaboration, 2020

The results of a test conducted in Slovakia based on conscious feedback show that most respondents consider the smell of chocolate to be the most pleasant scent for the sweets department in a grocery store (34%). The second most frequently reported was the smell of coffee (15%). While orange (7%) and nougat (6%) were being the least reported scents (see Figure 4.6). Based on the results of the explicit part of the association test, in all six countries tested, respondents considered chocolate to be the most appropriate scent for the sweets department.

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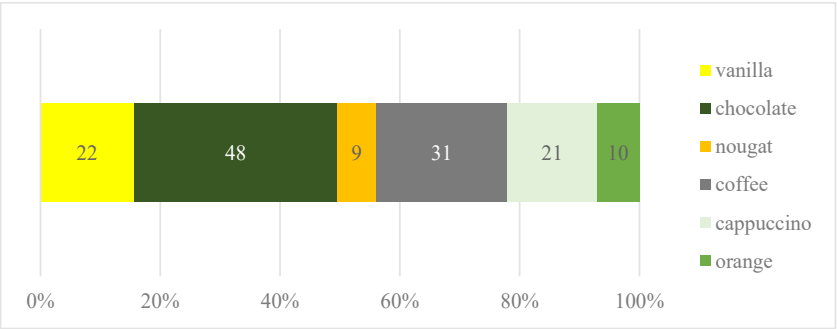

Figure 4.6 Selecting aromas for the sweets department
Source: Authors´ own elaboration, 2020

The test also used control questions that asked participants to recommend, on a scale of 0 to 10 (with 10 being the most appropriate), the aromas for the sweets department. Each aroma evaluated was presented to them via a graphic visual. During the selection process, the respondents' emotional response was monitored through facial biometrics. The differences in valence (polarity of emotions) are presented in Figure 4.7. If the valence values take positive values, it is a positive perception, if the value is 0, it is a neutral perception and in case of negative values we talk about a negative perception. From the results, the most positive perception can be seen in the case of vanilla scent (0.04). The perception of chocolate (0.0015) and coffee (0.021) were also perceived positively. An interesting finding is that nougat, which was identified by the fewest respondents (6) in the initial selection as a suitable aroma for the sweets department, however, in this case it achieved a better subconscious response (0.001) than the cappuccino aroma (-0.01), which was recommended by only 21 respondents.

Based on these findings in the online environment, we selected 5 aromas (vanilla, chocolate, nougat, coffee, orange) to be tested in laboratory conditions in Experiment 3.

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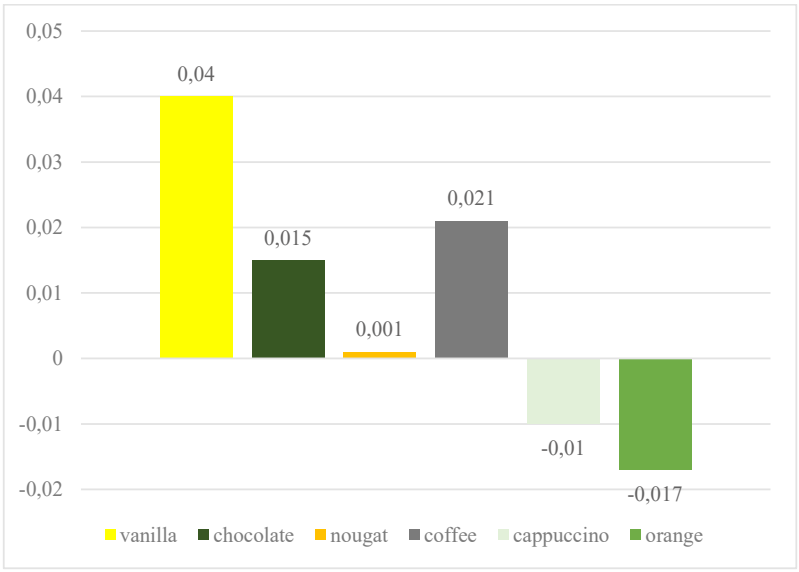

Figure 4.7 Polarity of emotions when recommending aromas for the sweets department
Source: Authors´ own elaboration, 2020

The experiment in laboratory conditions was conducted using facial biometrics and electroencephalography. The selected scents were labelled with the number from 1 to 5 and placed in identical glass vials using a special paper with suction capability. These were tested by the participants in a specialised aroma box (Figure 4.8), which simulated the conditions of a sweets sales department in Kaufland Nitra store in terms of air quality.

Figure 4.8 Special aromatization box for aroma testing
Source: Authors´ own elaboration, 2020

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The testing of conscious and unconscious perception of the selected aromas included an olfactory sensitivity test (Figure 4.9). All participating respondents were presented with the Sniffing Test from the producer Burghart. The purpose of the test was to determine the threshold of sensitivity to a selected odorant (N-Butanol, gradient of 20 concentrations) and to determine at what concentration the respondent is able to detect the olfactory stimulus.

Figure 4.9 Olfactory sensitivity test
Source: Authors´ own elaboration, 2020

Based on the measurement of electrical brain activity, processing of the recorded data, and after excluding extreme values, we created a graph of median scores for engagement (Figure 4.10) and arousal (Figure 4.11) for each emotion.

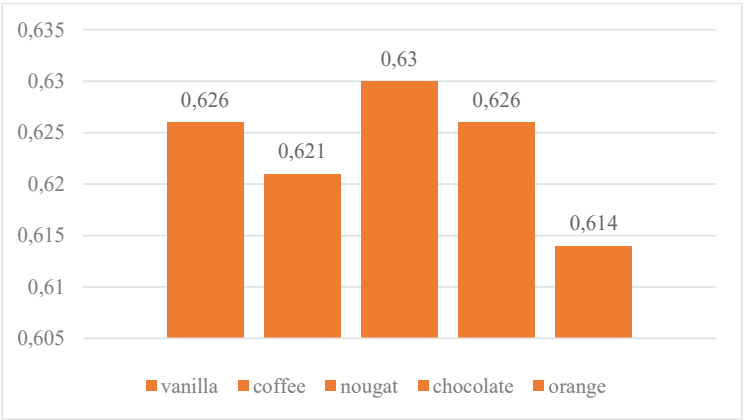

Figure 4.10 Engagement scores on measures of the effect of the subject aromas on emotional response
Source: Authors´ own elaboration, 2020

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Based on the median of this emotion, the highest level of emotional involvement was observed for nougat scent. This may be due to the more difficult identification and the olfactory imprint of multiple recognizable odors cumulated into this aroma and the respondents' efforts to identify it. This assumption is supported by the fact that the citrus scent of orange achieved the lowest level of bias, while respondents were also the best at identifying it.

Excitement is an important emotion as it speaks to a certain level of active involvement and anticipation. When a consumer is aroused, other types of emotions are experienced more intensively, which have a major impact on the decision-making process. Based on the median, the highest arousal rate was for coffee and nougat scents (0.47). As mentioned above, this could be due to a lower recognition ability, but also due to the associations that the given aroma compound (coffee) evoked.

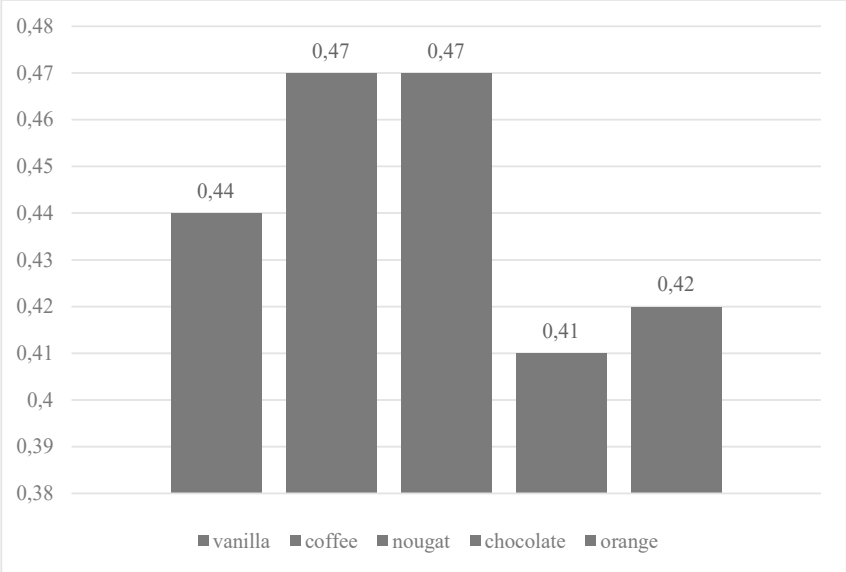

Figure 4.11 Comparison of arousal scores by the influence of aromas on emotional response
Source: Authors´ own elaboration, 2020

Subsequently, an experiment of aromatization deployment in real conditions was carried out. Due to the pandemic situation, real research was only carried out in three countries – Slovakia, Spain, Poland – see Figure 4.12.

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Figure 4.12 Countries involved in real conditions research
Source: Authors´ own elaboration, 2020

Based on the results of the association test and for comparison purposes, the chocolate scent was deployed in the sweets department. In addition to aromatization, a special kiosk was also deployed in the department to collect conscious and unconscious feedback (Figure 4.13).

Figure 4.13 Special kiosk for collecting conscious and unconscious feedback
Source: Authors´ own elaboration, 2020

In Slovakia, the data collection took place in Kaufland retail store for 20 days in the pre-Christmas period (from 10/11/2020 to 30/11/2020) with aromatization and in the pre-Easter period (from 22/02/2021 to 14/03/2021) without aromatization. The results based on the average daily

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responses show approximately the same evaluation of the atmosphere of the sweets sales department in the pre-Christmas period (average value 1.80; 1,580 responses) and in the pre-Easter period (average value 1.88; 1,216 responses). These results may be largely influenced by the spread of the pandemic and mandatory upper respiratory protection. For these measures, even subconscious feedback could not be obtained.

After consultation with the Business Intelligence department of Kaufland Slovakia, PLC, we decided to compare the economic data in the Nitra store for the same period with the reference store in Trnava, in which aromatization was not deployed in the sweets department. The reason for not comparing the data with the same period of the previous year was primarily due to the concern of significant distortion of the results and findings. In this context, data analysts from Kaufland also confirmed changes in consumer behaviour and a significant decrease in turnover in individual product categories, which could substantially distort the results of the impact of aromatization.

The total difference in sales of sweets in the monitored operations represents the amount of € 25 514 (4%) in favour of the Nitra operation. The higher turnover of sweets in the Nitra store could also be largely related to the fact that there is only one Kaufland store in Nitra, whereas there are two in Trnava. Nitra also has almost 12 000 more inhabitants than Trnava.

Since sales of sweets are also largely influenced by various promotions, discounts, hardsell communication or assortment mix (seasonality), we decided to compare the unit sales of goods items in individual sweets sub-categories in the Nitra and Trnava stores for the period 10/11/2020 – 31/01/2021. The total difference between the number of units sold in the Nitra store and the reference store is 37 661 units (7%) in favour of the Nitra store, where the chocolate scent was deployed.

Given the above, it should be noted that the direct effect of aromatization did not have a significant effect on sales and the number of units sold, but on the other hand, the operation in which aromatization was deployed in the period under review experienced a year-on-year decrease in sales of 4%, i.e. a smaller decrease compared to the reference operation (6%). Overall, the Nitra store's turnover within the sweets product category was 5% higher in the period 46th week 2019 – 4th week 2020 and 7% higher in the period 46th week 2020 – 4th week 2021, representing a difference of € 37 133 compared to the Trnava store.

At the same time, we decided to compare the sales and the number of units sold in the Nitra store within the seasons, which are typically characterized by increased purchases of sweets (Table 4). The results of the comparison show that in the pre-Christmas period, when flavouring was deployed in the store, there was a 26% higher quantity turnover in sweets, which represents a difference of 35 140 units of these items. This can largely be related to aromatization, since in the same period of the previous year

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the difference in seasonal comparison of the quantity sold in this section was 11%, which represents an increase in the difference of 15%.

Table 4 Seasonal comparison of sales and quantity turnover in Kaufland Nitra

Season	Period	Gross sales in €	Quantity turnover in pieces	Aromatization
Christmas	10. 11. 2020 – 30. 11. 2020	194 347,40	172 686	Chocolate
Easter	22. 02. 2021 – 14. 03. 2021	165 848,81	137 546	None
Difference		28 498,89	35 140	
Index		1,17	1,26	

Source: Authors´ own elaboration, 2020

Hence, our assumption about the impact of the aromatization of the sales department on consumer decisions is partially confirmed in the form of a 15% year-on-year increase in sweets sales on a seasonal comparison, but also a smaller overall year-on-year decline in sales (down 4%) in the sweets department due to the pandemic compared to the reference operation (down 6%).

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5 USING SCENTS IN RETAILING: WHAT DO WE KNOW, AND WHERE DO WE GO FROM HERE?

5. 1 Introduction: Why use scents in retailing?

Scents are an important part of everyday life and since the early history of mankind have been used in e.g., religious ceremonies and traditional treatments. The sense of smell is unlike other senses, intimately connected to emotions and memories. Accordingly, whenever we smell something it may be hard to describe the smell in any detail, but we can easily and quickly determine whether we like it or not and whether we have encountered it before. Nowadays scents are interesting for business-owners and retailers who want to create better in-store experiences for their customers, as scents are indeed known to affect people's mood and overall experience with different environments.

The field of study that deals with the effect of scents on human behavior, whether in a business, health or purely scientific context, is known as "aromachology" (Krishna, 2012; Giacalone, Pieranski and Borusiak, 2021).

Interest in aromachology has increased in recent years, and accordingly we see that the number of publications related to aromachology in the scientific literature has been steadily increasing in recent years, as well as the number of citations to these publications (Figure 5.1).

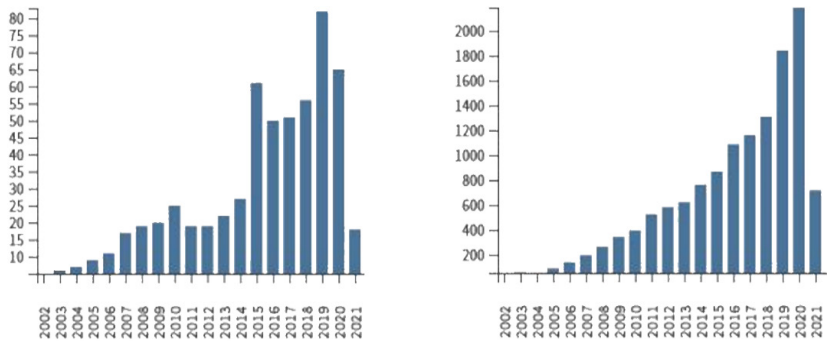

Figure 5.1 Number of scientific publications (left) and numbers of citations (right) relating to aromachology in the last twenty years
Source: Author´s own elaboration on data from the Scopus database (Elsevier)

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As shown in Figure 5.2, research on aromachology come from a wide variety of fields, ranging from disciplines natural and technical disciplines (generally concerned with characterizing and understanding the chemistry of odors and how to extract them from different source materials) to social and business sciences (generally interested in understanding the effect of odors in human behaviors.

Figure 5.2 Publications relating to aromachology (N=617) – breakdown by scientific field

Source: Giacalone, Pieranski and Borusiak, 2021

As shown in Figure 5.2, however, the relative majority of research in (or mentioning) aromachology comes from fields such as management and business. The reason for this is that both service and retail companies are highly interested in creating strong and appealing in-store experiences, and the use of scents is an increasingly popular way to achieve that. The use of scents is also very helpful to differentiate the brand beyond the traditional marketing mix (Krishna, 2012; Spence et al., 2014). At the high-end women's fashion store AnneFontaine, for instance, the staff sprays the signature scent throughout the store, as well as on all purchases after they have been placed in the shopping bags (Spence et al., 2014). Other popular examples include the signature scents of major clothing chains such as Abercrombie & Fitch and hotel companies such as Marriot and Westin.

Scents are an especially powerful way to provide customers with better in-store experiences, with a view to extend the time they spend in the store and the likelihood that they will visit again. Accordingly, scents are increasingly recognized as an important aspect of the overall sensory experience customers have with the retail environment, next to inputs from other sensory modalities such as the lightning, the color of the walls, the presence of background music, etc. (Figure 5.3). These aspects - collectively known as retail "atmospherics", a term coined by famous marketing author

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Philip Kotler (1973) – refers to the atmosphere or mood that companies create in your store by way of introducing various elements and effects.

Scents can influence in-store customer behavior in essentially two ways. One is the "affective" route which deals with aspects such as valence (is the smell pleasant or not?) and arousal (is the smell interesting or boring?). In other words, pleasant scents which provide an optimal level of arousal will result in a customer positive experience with the store, more time spent dwelling in the store, and a higher chance they will want to revisit it (Bakker et al., 2014; Jacoby, 2002; Spence et al., 2014). Another way in which scents can affect customer behavior is by acting as cues or facilitators towards specific products (the "cognitive" route in Figure 5.3) by exploiting associations known to consumers. For instance, as reported in Ellison and White (2000), a freshly starched cotton scent has been released as shoppers walk by certain display stands in the Thomas Pink shirt store, and many retailers often experiment with scents linked to specific holidays (e.g., cinnamon during Christmas, chocolate during St. Valentine) to boost sales of items associated with that particular time of the year. Of course, the affective and cognitive routes are not mutually exclusive, quite the contrary. Think, for instance, to the smell of freshly baked bread, which both gives consumers a pleasant experience (fresh bread smells good!), but also communicates information about the presence and the characteristics of the products (bread is near and probably still warm).

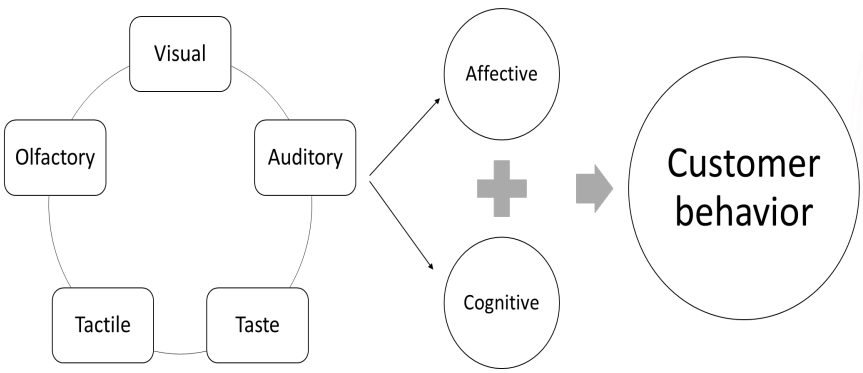

Figure 5.3 Framework for multisensory influences on customer behavior
Source: Adapted from Spence et al., 2014

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5. 2 Do scents affect customer behavior? What does the evidence say (and how good is it)?

Press and web articles stories frequently discuss the use of scents in different retail settings by major brands. For instance, Samsung have purportedly introduced a signature honeydew melon scent into all of its stores, and at the Sony Style store, "the subtle fragrance of vanilla and mandarin orange – designed exclusively for Sony – wafts down on shoppers, relaxing them and helping them believe that this is a very nice place to be" (Spence et al., 2014, p. 476). But just how good is the evidence for the effect of scents on customer behavior?

The scientific literature certainly offers examples of successfully using scent in different store environment. For example, a famous study by Spangenberg and collaborators (Spangenberg et al., 2006) investigated the effect of adding a vanilla scent to a women's department and a sweet floral scent ('Rose Maroc') to the men's section of a clothing store. Importantly, these scents were tested in the lab prior to being used in the actual store to ensure that they appealed to women and men, respectively). Their results showed that sales almost doubled in both sections of the store after introducing the scents, whereas a negative impact on store sales was documented when the two scents were switched. Other published studies suggest that releasing the "right" scent can prompt customers to stay longer in store and to have a more positive experience of the store itself (Schifferstein – Blok, 2002).

However, when considering the available literature as a whole, it is clear that this is field of study is still somewhat in its infancy, in particular when it comes to scientific studies conducted in actual retail environments, as opposed to laboratory-based studies. Giacalone, Pieranski and Borusiak (2021) in a recent comprehensive review on the topic found only 20 scientific publications focusing on aromachology conducted in actual retail environment and containing actual data on customer behavior (such as time and money spent in the store).

These studies covered a wide range of product categories and retail environment. The relative majority of studies have been conducted in fashion stores (clothing, accessories, etc.) but also in product categories as diverse as books and magazines, household appliances, slot machines, and travel packages (Figure 5.4). For the most part research has focused on customer behavior towards physical products available for purchase during the customer visit with a few exception: for example, a study who money gambled on slot machines in a Las Vegas Casino (Hirsch, 1995).

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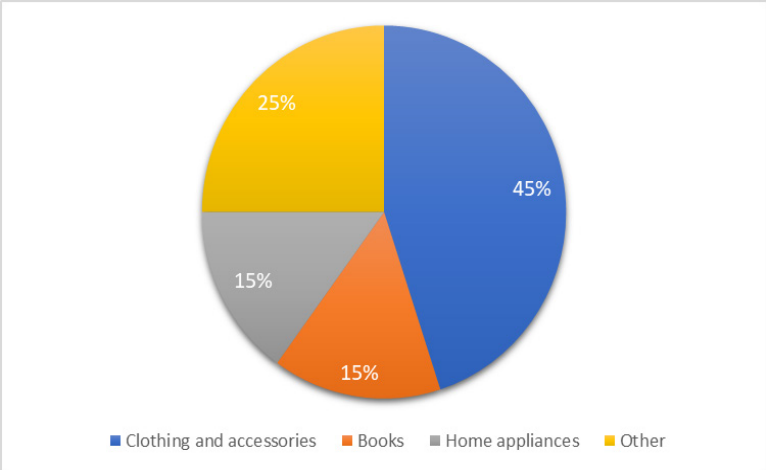

Figure 5.4 Product categories represented in published research on aromachology conducted in actual retail environments (N=20)
Source: Author´s own elaboration on data presented in Giacalone, Pieranski and Borusiak, 2021

Despite the limited evidence available, we can try to draw some conclusions based on the available literature. All studies employed pleasant scents – this is of course not surprising given what we know about the role of pleasant smells (not to mention it would understandably be a hard sell to convince a store owner to diffuse unpleasant smells in their store in the name of science). Accordingly, most studies report that addition of a pleasant smells on attitudinal aspects, e.g., engagement with the store, satisfaction with the experience, intention to revisit, etc, measured through questionnaires administered at the end of the store visit.

Evidence of effects on actual customer behavior is not always straightforward. For example: Ward and collaborators (Ward et al., 2007) found that adding a pleasant scent made the store more engaging for the customers, but did not increase sales compared to a control condition (without scent). Other studies found that, when using two or more different, but equally pleasant scents only one out of the two actually affected customer behavior. An example of this is the already mentioned study in a Las Vegas Casino by Hirsch (1995) where only one of two scents the amount gambled on slot machines. In another study, conducted in an optics store (Madzharov, Blok and Morrin, 2015) a warm scent increased sales, whereas a cool scent (both equally pleasant) did not. The bottom line, therefore, seems to be that pleasantness is not enough to produce a desired effect on customer behavior.

Does this mean that the other proposed mechanism, the “cognitive” route in Figure 5.3, is the more important of the two? Some studies support this idea. In a study conducted in a bookstore by Parson (2009), a scent

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congruent with the store (coffee) was found to increasing sales and book browsing more than another, less congruent one (rose). Perhaps the best evidence of this is the already mentioned the study by Spangenberg and collaborators (Spangenberg et al., 2006), which found a positive impact of adding a "masculine" or "feminine" scent on sales of, respectively, men's and women's clothing items.

Unfortunately results from other studies are less clear-cut. In another bookstore field study (Doucé et al., 2013), adding a chocolate scent to a bookstore increased buying behavior towards thematically congruents books (romantic novel), but only for women (men were unaffacted). Schifferstein and Blok (2002) investigated whether magazine sales in bookstores would be boosted by adding two odors (a grass odor, purportedly associated with sports and gardening magazines, and a sunflower odor, associated with personal care and women's magazines), but neither scent was found to increase sales for the magazines they would supposedly be thematically congruent with (as cold comfort, they did not decrease sales for incongruent magazines either). Finally, Ward and collaborators (Ward et al., 2007) reported no differences in the time spent by customer spent in store (an electrical retail store in that case) when a congruent scent was present.

Summing up, we know that scents as part of the store atmospherics can affect customer in-store behavior, the jury is still out there when it comes to understanding exactly how this works and what characteristics, besides pleasantness, a scent must possess to actually influence customer behavior. What could be behind these inconsistencies and null results?

There are different possible explanations. Some believe that it has to do with differences between stores environments and interactions with other retail atmospherics. This is almost certainly a factor because scents will inevitably interact with other retail atmospherics which makes comparing the effect of scents across studies harder than unlike in a laboratory study where researchers can control other conditions. Another possible problem relates to the intensity of the scents, and whether they are perceived or not. This is an important aspect for two reasons: first, because the psychological effect of scents is different depending on whether one is consciously perceiving them or not (REF); secondly, scents that are clearly perceived may produce more enjoyable experiences but may actually distract customers from their shopping goal or, even worse, being experienced as a possible form of manipulation on the part of the store owner (REF). Moreover, as explained by Schifferstein and Blok (2002), it is not enough that a scent is conceptually congruent with a product (say, a grass scent with a gardening magazine) to enhance its sales: customers might actually perceive it as such, and even if they do, it may not be enough to affect that product's sales.

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A third issue evidenced in the review by Giacalone, Pieranski and Borusiak (2021) is that the methodological details of field studies are often not very clear, even when it comes to crucial details such as which scent was used, whether customers were aware of its presence, what kind of diffuser was used, how many and in which area(s) of the store it was located, and so on. This makes it hard to compare results across studies which may differ in key methodological details.

There is one final aspect that is problematic with current research in aromachology: most studies only examined the data at the aggregated level, disregarding individual differences in the way people experience smells – this is a big topic so we will deal with it in the next section.

5. 3 Our unique sense of smell: individual differences and why the matter for aromachology

When talking about the sense of smell, an important concept to keep in mind is that the way we experience a scent is not simply a reaction to the chemical compounds that make it up but, instead, is also influenced by our previous experience with the scent, whether we encounter it before (and how often), our knowledge of what the scent is, as well as by a multitude of demographic and even genetic differences between people. Your genes and your experiences give you a unique world of smell. Of course, this principle is true for all senses: think, for instances, of color blindness which is a very common genetic disorder causing differences in the way people see. However, this becomes magnified and much more consequential when talking about smells given the difference in function that the sense of smell has compared to other sensory modalities, but also the very high numbers of smells that humans can perceive (far higher than any other physical stimuli from other senses). To keep the comparison with olfaction we know that color, for instance, can vary in three main dimensions: red, blue, and green. How many dimensions exist for smells? Humans have more than 400 odorant receptors genes which would suggest that there exists at least an equal amount of different scent molecules that we can detect and by combining them the number can quickly get much higher. The lay and scientific literature generally estimate the number of smells people can identify at around 10.000, and a famous paper published in the prestigious Science magazine even claimed this number to be 1 trillion! (Bushdid et al., 2014). Whatever the number is (nobody knows yet), it is sure to be a very high number and with this comes a lot of variation between one person and another.

Let us look at the most important sources of variation (that we know of), and how they might be relevant in the context of aromachology research. The first one is sex: women consistently outperform men on standard tests of smelling ability, including odour “threshold” (what is the faintest/smallest

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concentration of a smell a person can detect), "discrimination" (can the person distinguish between intensities of the same smell) and "identification" (can a person recognize the smell correctly). Although the difference between men and women is not very large, it is a very robust result that has been replicated multiple time (Sorokowski et al., 2019).

Age is another major factor. Our smelling ability increases and reaches a plateau in early childhood, and steadily declines with old age (Figure 5.5), particularly around the sixth decade and onwards, although some researchers claim that our sense of smell begins to deteriorate long before that.

This may seem like a detour from the topic of aromachology, but it underlines a very important point: scents may be experienced by customers in a different way than intended by the experimenter of business owners. For example, many scientific papers pre-test scents with students who are generally young and therefore probably not representative of the store customer (unless the store is a campus store of a local university) a scent may be experienced as strong by a 20-year-old person but may be very faint, or even undetectable, to a person aged 60.

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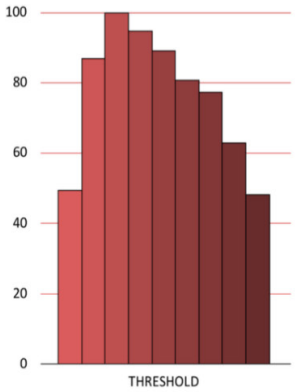
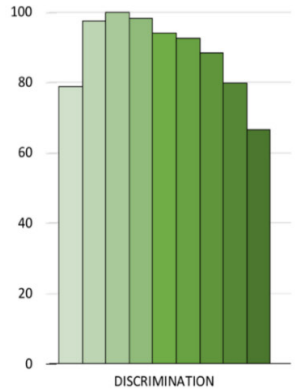
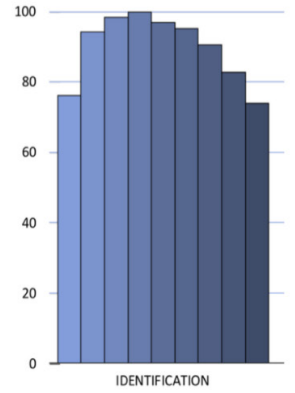


Age group [years]	5-10	11-20	21-30	31-40	41-50	51-60	61-70	71-80
11-20	-3.53***							
21-30	-4.77***	-1.25***						
31-40	-4.29***	-0.76**	0.49					
41-50	-3.74***	-0.22	1.03***	0.54				
51-60	-2.95***	0.57	1.82***	1.34***	0.79**			
61-70	-2.62***	0.90**	2.15***	1.66***	1.12***	0.33		
71-80	-1.26	2.26***	3.51***	3.02***	2.48***	1.69***	1.36**	
over 81	0.13	3.65***	4.90***	4.41***	3.87***	3.08***	2.75***	1.39



Age group [years]	5-10	11-20	21-30	31-40	41-50	51-60	61-70	71-80
11-20	-2.43***							
21-30	-2.78***	-0.35						
31-40	-2.55***	-0.12	0.23					
41-50	-2.00***	0.43	0.78***	0.56**				
51-60	-1.80***	0.62***	0.97***	0.75***	0.19*			
61-70	-1.25***	1.18***	1.53***	1.30***	0.74***	0.55*		
71-80	-0.15	2.28***	2.63***	2.41***	1.85***	1.66***	1.11***	
over 81	1.60**	4.03***	4.38***	4.15***	3.59***	3.40***	2.85***	1.75***



Age group [years]	5-10	11-20	21-30	31-40	41-50	51-60	61-70	71-80
11-20	-2.52***							
21-30	-3.06***	-0.54***						
31-40	-3.29***	-0.77***	-0.23					
41-50	-2.87***	-0.36	0.19	0.42				
51-60	-2.63***	-0.11	0.43**	0.66***	0.24*			
61-70	-1.99***	0.53*	1.07***	1.30***	0.88***	0.64**		
71-80	-0.91	1.60***	2.14***	2.38***	1.96***	1.71***	1.08***	
over 81	0.30	2.82***	3.36***	3.59***	3.18***	2.93***	2.29***	1.22

Figure 5.5 Changes of odor threshold, discrimination, and identification across age groups (N = 9139). Tables in the right panel present differences between mean scores of two groups (group in a column − group in a row) and the level of post-hoc test significance: ***p < 0.001; **p < 0.01; *p < 0.05. Note that the reason why children (2-10) appear to perform poor is that these tests require understanding questions, however they generally match and even outperform young adults in tests that do not require language.
Source: Oleszkiewicz et al., 2021

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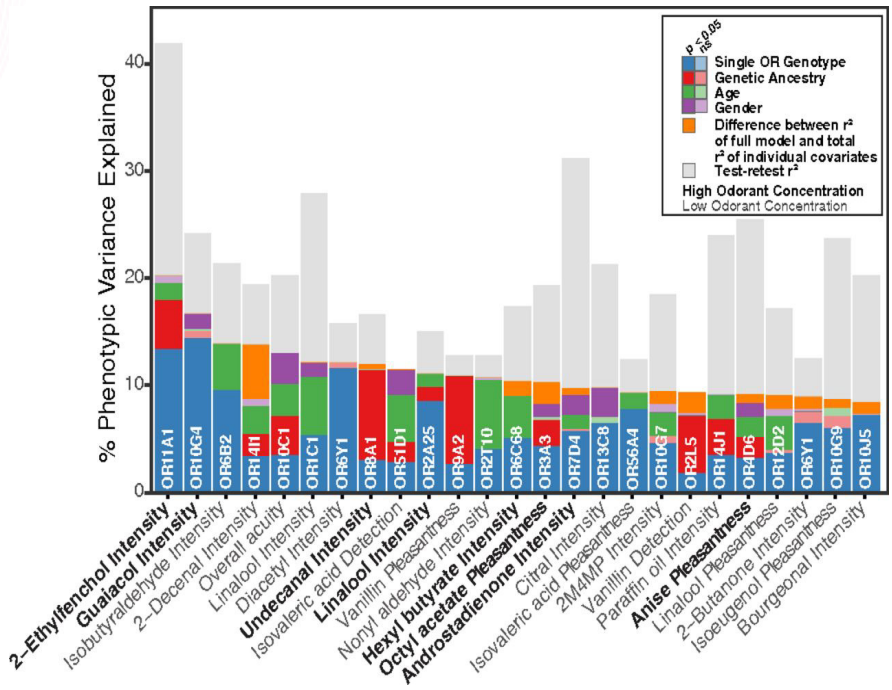

Figure 5.6 Relative contributions (amount of variance explained) of genetics and demographic factors to variation in perception of different smells. Bold type indicates a high intensity of a smell, and regular type indicates a low intensity.
Source: Trimmer et al., 2019

To make matters more complex, research on genes that encode for olfactory receptors (OR, i.e. specialized sensor proteins in our nose that can be activated by different smell molecules) have discovered extensive differences in how we smell, for example how strong and how pleasant an odor is going to be (Trimmer et al., 2019). In other words, if two people smell the exact same molecule, one person may detect, say, a fruit smell, while the other may smells nothing at all. An example you may be familiar with is cilantro (coriander), whose flavour many people love while others find it extremely unpleasant and describe it as like soap or dirt: whether one falls into the former or latter group is due to genetic variants in olfactory receptors (Eriksson et al., 2012). It turns out that these differences are extremely common and affect a wide variety of smell molecules. Figure 5.6 shows the contribution of genetics to smell perception relative to that of age and gender (based on data from Trimmer et al., 2019) for a long list of smells for which there is a known difference in perception across people (that we know of, the majority of these are still unknown): variation in olfactory receptors is almost always the most important factor. In other

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words, genetics give everyone a unique sense of smell, and we have only begun to grasp how this works what the implications are.

There is at least another extremely important factor to consider. Even if we could somehow keep all these previous (age, gender, genetic makeup) constant. Our brain's processing of smells is not simply a reaction to the molecules that make up the scent, but is largely influenced both by our previous experience with the scent and whether we know it or not (this is an example of what psychologists call "top-down" processes, which essentially means that the brain does not just passively process information coming from the senses but also actively interpret and modifies them). A very good predictor of what smells we have encountered in our life (and how often) is, of course, a person's cultural background.

Accordingly, researchers have uncovered vast differences in the way people from different cultures respond and describe smells, and different languages are more or less apt to describe smells. A striking example of this is given in Figure 5.7, which shows an example from a study compared Dutch and Jahai (a hunter-gatherer community in the rainforest of the Malay Peninsula) in the way they describe different smells and how long it would take them to do so. Jahai speakers used overwhelmingly abstract odour terms and take around 2 s to name odours, whereas Dutch participants use predominantly concrete descriptors and take around 13 s to name odours. Even when people who share the same language may nonetheless react differently to the same smells. For example, Ferdenzi et al. (2017) compared French speakers from France and Canada (Quebec) in their reactions of different scents. Participants were asked to smell each scent and rate how pleasant, intense and familiar it was. The researchers also recorded non-verbal reactions to the smells, for example changes in facial expressions and hearth rate. The researchers found significant differences between French and French-Canadians for almost all smells in a way that reflected geographical differences (for example, Canadians were more familiar with scents of maple and wintergreen and rated them as more pleasant than the French did).

This is of course very important to consider for practitioners of aromachology working in multicultural contexts (e.g., global chains), but also should be a wake-up call for researchers as most of existing literature comes from so-called WEIRD countries (White, Educated, Industrialized, Rich and Democratic) and may or may not apply cross-culturally.

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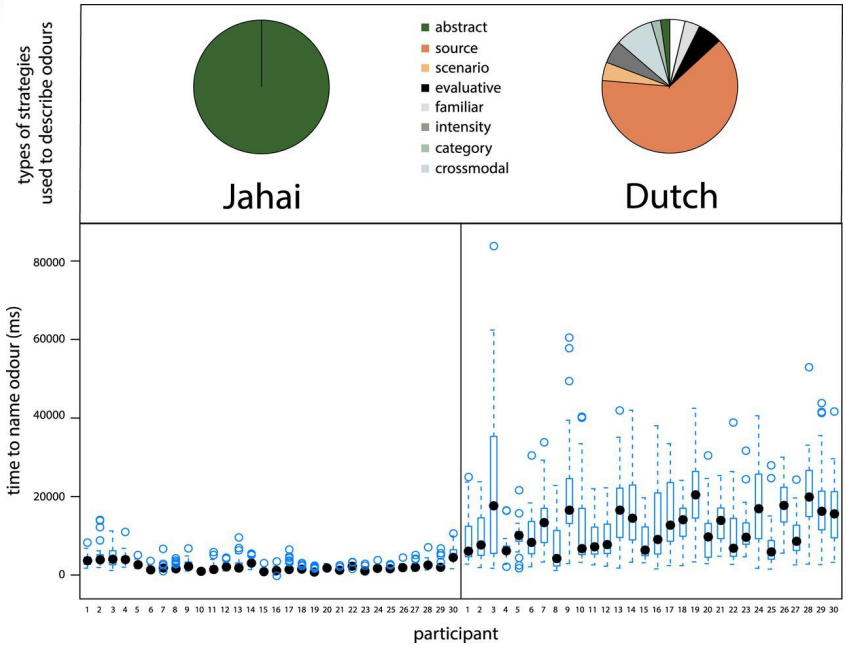

Figure 5.7 Strategies used to describe odours by Jahai and Dutch participants (top), and time taken to name odours by language and participant (bottom)
Source: Majid et al., 2018

In conclusion, while we are probably only scratching the surface of understanding these differences in smell abilities, researchers and retailers interested in aromachology need to come to the realization that their scent of choice will likely not have the same effect across all their customers, and certainly is not going to be perceived in the same way by all. Moving on from "one-size-fits-all" approaches and finding out what works for specific target groups is probably extremely important for the success of aromachology studies and applications.

5. 4 Conclusion: Where do we go from here?

Aromachology offers retailers the possibility to provide customers with better in-store experiences and potentially increase turnover. When it comes the available evidence supporting effects on customer behavior, the results are promising, but the field of study is clearly still in its infancy and one should be wary to assume that results obtained in highly controlled environments (e.g., a lab or virtual reality) replicate to the real world. Research coming from actual retail environment is, as we have seen, very limited and less conclusive

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than lab-based results. There are some critical issues that should be considered in future research. For example, it is essential to consider individual differences and beware of aggregated-level analyses. Another important issue to consider going forward is how scents interact with other retail atmospherics (see Figure 5.1) to create multisensory experiences. Only very few studies have done that so far, but when they did (e.g., Spangenberg et al., 2005), they generally found that combining different retail atmospherics (for example, scent and lightning, or scents and background music) has a different effect on customer behavior than when they are present separately.

In conclusion, the field is still somewhat in its infancy when it comes to scientific studies conducted in actual retail environments. As interest in aromachology keeps increasing, we can look forward to future discoveries that will further our understanding of this topic.

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6 AIR QUALITY AS A KEY FACTOR IN AROMATIZATION OF INDOOR SPACE

6. 1 Introduction

The scientific literature on indoor air quality is categorized mainly to environmental sciences, construction building technology, environmental and civil engineering. Indoor air is a complex and dynamic mixture of a variety of volatiles and particulate matter. Some of the constituents are odorous and originate from various sources such as construction materials, furniture, cleaning products, goods in stores, humans and many more. The first part of the chapter summarizes the knowledge of substances that are found in the air inside buildings and have a negative impact on our health. This issue has been monitored for a long time and so, using a better methodology, it is possible to identify even low concentrations of monitored substances. The second part summarizes the possibility of analysis of volatile compounds from the air.

The air is a common name for atmosphere of Earth. Dry air contains, by volume, 78.09% nitrogen, 20.95% oxygen, 0.93% argon, 0.04% carbon dioxide, 0.0018% neon and small amounts of other gases. The concentration of water vapour varies significantly from around 10 ppm by volume in the coldest portions of the atmosphere to as much as 5% by volume in hot, humid air masses (Schubert – Walterscheid, 2000).

The human sense of smell is very sensitive even if it does not reach the sensitivity of some mammals and other members of the animal kingdom. There are substances in the air whose smell can be unpleasant but not harmful to human health, but sometimes the sense of smell can warn a person of potentially harmful substances. Sometimes people can smell certain chemicals in the air before they are at harmful levels.

Scientists have long studied the quality not only of outdoor air, but also of air in homes, workplace, hotels, offices and stores as people spend more and more time there.

Some studies have found that retail store air quality will often be worse when outdoor air pollution is at a high level, and that it can affect store employees and consumers. On the other side, the air modification has come to the forefront of researchers' interest in recent time in order to create a more pleasant environment and possibly increase sales when applied in the stores.

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6. 2 WHO and EU legislation concerning air quality

Air pollution has been one of Europe's main political concerns since the late 1970s and it is a topic with growing interest in the world. The first edition of the World Health Organization (WHO) Air quality guidelines (AQGs) for Europe was published in 1987. Since then, new data have emerged and new developments in risk assessment methodology have taken place, necessitating the updating and revision of the existing guidelines.

In 2000, the second edition of book on Air Quality was published. It is a large study of 288 pages, divided into three parts. The first part contains general information, the second part is about Evaluation of risks to human health, and it is divided into 4 chapters. Chapter Organic pollutants describes Acrylonitrile, Benzene, Butadiene, Carbon disulfide, Carbon monoxide, 1,2-Dichloroethane, Dichloromethane, Formaldehyde, Polycyclic aromatic hydrocarbons, Polychlorinated biphenyls, Polychlorinated dibenzodioxins and dibenzofurans, Styrene, Tetrachloroethylene, Toluene, Trichloroethylene, Vinyl chloride. Chapter Inorganic pollutants is divided into Arsenic, Asbestos, Cadmium, Chromium, Fluoride, Hydrogen sulphide, Lead, Manganese, Mercury, Nickel, Platinum, Vanadium. Among Classical pollutants belong Nitrogen dioxide, Ozone and other photochemical oxidants, Particulate matter, Sulphur dioxide. The chapter on Indoor pollutants is divided into Environmental tobacco smoke, Man-made vitreous fibres and Radon. The last part of the book deals with Evaluation of ecotoxic effects. In addition, it describes the various aspects that need to be considered by national or local authorities when guidelines are transformed into legally binding standards. For detailed information on exposure and on the potential health effects of the reviewed pollutants, the publication links to the Regional Office's web site, where the background documents on the individual air pollutants can be accessed.

The other edition of WHO AQGs for ambient air pollutants was published in 2006 and included recommendations for the classical air pollutants particulate matter (PM), ozone (O_3), nitrogen dioxide (NO_2) and sulfur dioxide (SO_2). The World Health Assembly (WHA) Resolution recognized the role of WHO AQGs for both ambient air quality and indoor air quality in providing guidance and recommendations for clean air that protect human health. As a result, in 2016 WHO started the work towards the update of the Global Air Quality Guidelines. The first major instrument was the Air Quality Framework Directive 96/62/EC and its daughter Directives, which established standards for a range of pollutants including ozone, particulate matter (PM10) and nitrogen dioxide (NO_2), in the period up to 2004.

The air pollution country fact sheets summarize key data on air pollution for each of the 33 European Economic Area (EEA) member countries. Indicators on past and future emission trends are presented, as well as a summary of the national air quality situation in each country.

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The World Health Organization is in the year 2021 in the process of updating its Global Air Quality Guidelines. The Special Issue from February 2021 aggregates systematic reviews and other supporting evidence, presents the context of the work, and summarises important methodological information about the approaches taken.

6. 3 Indoor health risk substances

There are many works that deal with what substances and why they are found in the air in buildings and how they can affect our health. In 1999 Jones published the review in which he summarized information from more than 200 papers and discussed the current understanding of the relationship between indoor air pollution and health. The article is divided into paragraphs where it deals with the most frequent pollutants such as carbon dioxide (CO_2), carbon monoxide (CO), total hydrocarbon (THC), formaldehyde (HCHO), respirable particulate matter (PM10) and airborne bacteria. He discussed what kind of pollutants can influence the quality of indoor air, the range of sources and measured concentrations of individual substances in the air. Table 1 shows the most observed pollutants, their source, health effects and some measured concentrations from selected works.

Table 1 Chemical compounds in air in buildings, resources, and potential health effect

Chemical compounds	Resources	Potential health effect	Some finding concentration
Allergens	House dust, domestic animals, insects	asthma	
Asbestos	Fire retardant materials, insulation	skin irritation	
Benzene			
Carbon dioxide	Metabolic activity, combustion activities, motor vehicles in garages	asphyxiant, and can also act as a respiratory irritant, headaches, dizziness, and nausea	54860 mg/m^3

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Carbon monoxide	Fuel burning, boilers, stoves, gas or kerosene heaters, tobacco, smoke	headache, fatigue, dizziness, and nausea	3657 mg/m^3
Formaldehyde	Particleboard, insulation, furnishings	sneezing, coughing, skin irritation and minor eye irritation	0.08–2.28 mg/m^3
Micro-organisms	People, animals, plants, air conditioning systems		
Nitrogen dioxide	Outdoor air, fuel burning, motor vehicles in garages		
Organic substances	Adhesives, solvents, building materials, volatilisation, combustion, paints, tobacco smoke		
Ozone	Photochemical reactions		
Particles	Re-suspension, tobacco smoke, combustion products		
Polycyclic aromatic hydrocarbons	Fuel combustion, tobacco smoke		
Pollens	Outdoor air, trees, grass, weeds, plants		
Radon Soil	Building construction materials (concrete, stone)	Lung cancer	45.3 – 150 Bq/m^3

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SO_2	Burning coal, fuels,	chronic respiratory complaints, respiratory symptoms	(52 – 78 μg/m^3)
Respirable particles			
	burning of wood and fossil fuels	respiratory illness,	respirable particles of different sizes
Tobacco smoke			
	cigarettes	eye, nose, and throat irritation	53.2 μg/m^3 in a study of 7 restaurants, whilst a median concentration of 355 μg/m^3
Fungal spores	Soil, plants, foods, internal surfaces	Atopic dermatitis, asthma, Rhinitis (and other upper respiratory symptoms)	

Source: Jones, 1999

6. 4 Quality of air in the shops

Much attention has also recently been paid to the quality of air in shops and large shopping centres. It turns out that the young generation in particular spends much more time in the shops than their parents' generation. Shopping centres thus provide not only opportunities to buy various goods like food, drugstores, electronics, furniture, etc. In the shopping centres people also spend time having lunch or dinner, sitting with friends, there are possibilities of various entertainments, including playrooms for children etc. Indoor air quality (IAQ) in stores is a key topic when studying the health benefits of shopping. Among many IAQ parameters, volatile organic compounds (VOCs) are at focus as they emit from numerous products and activities, e.g., detergents, paints, solvents, tools, clothes, toys, cleaning, and cooking. VOCs are hydrocarbons that exist as gases or vapours at room temperature. Scientists from Memphis measured concentrations of total VOCs (TVOC) in 32 retail stores using a high-sensitivity photoionization detector (PID) in their study from 2019. Indoor thermal comfort parameters, including temperature, relative humidity, and air velocity, were simultaneously measured using an anemometer. The store-level TVOC

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concentrations ranged from 30 to 869 ppb and exceeded the LEED guideline in 31 stores. TVOC levels were notably high in hardware stores (median = 536 ppb, $p = 0.0002$) and paints, household, and home accessories sections within stores ($p < 0.05$). TVOC levels were elevated in mornings and evenings, possibly due to low ventilation and cleaning activities at the beginning and end of business hours.

Li and collective studied the air in Hong Kong, which is considered one of the most attractive shopping paradises in the world. In order to characterize the indoor air quality in shopping malls, nine shopping malls in Hong Kong were selected for the study. The results showed that more than 40% of the shopping malls had 1-h average CO_2 levels above the 1000 ppm of the American Society of Heating, Refrigerating and Air-Conditioning Engineers (ASHRAE) standard on both weekdays and weekends. Also, they had average weekday PM10 concentrations that exceeded the Hong Kong Indoor Air Quality Objective (HKIAQO). The highest indoor PM10 level at a mall was 380 $\mu g/m^3$. Of the malls surveyed, 30% had indoor airborne bacteria levels above 1000 cfu/m^3 set by the HKIAQO. The elevated indoor CO_2 and bacteria levels could result from high occupancy combined with insufficient ventilation. The increased PM10 levels could be probably attributed to illegal smoking inside these establishments. In comparison, the shopping malls that contained internal public transport drop-off areas, where vehicles were parked with idling engines and had major entry doors close to heavy traffic roads had higher CO and PM10 indoor levels. In addition, the extensive use of cooking stoves without adequate ventilation inside food courts could increase indoor CO_2, CO and PM10 levels (Li et al., 2001).

Homburg et al. (2012) studied arousal congruity effects between three cues (i.e., background colour of the picture of the product, scent and music), making use of a lab experiment in which participants had to imagine browsing through a store. They found that congruent combinations of two high arousal atmospheric cues (e.g., a red background colour combined with fast music) led to positive consumer reactions, whereas the presence of three high arousal cues (i.e., red background colour, grapefruit scent and fast music) had negative effects.

6. 5 Analyses of volatile compounds from air

Air quality is essential for indoor comfort, shops, schools and other private and public buildings. Non-specific complaints such as irritation of the respiratory tract or eyes, dry skin or headaches that occur when people stay in a particular room or building are attributed to sick Building syndrome. The cause of these symptoms has not yet been clarified, but it is attributed to the presence of volatile organic compounds (VOCs). Several hundred

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different compounds have been identified in the interior of buildings, originating from the materials in the room as well as from human breath or skin. TVOC (total volatile organic compounds) levels can change during the day, in mornings and evenings, possibly due to low ventilation and cleaning activities at the beginning and end of business hours. Some substances that may be released from the materials used and humans into the environment are listed in Table 2 (Burdack-Freitag et al., 2017).

Table 2 Substances in air in buildings according to odorant source

Odorant source	Potential odorants e.g.
Plaster/gypsum	Aliphatic aldehydes ((E)-2-butenal, (Z)-4-heptenal), Aliphatic ketones (1-hexen-3-one) Organic acids (acetic acid, pentanoic acid, hexanoic acid)
Wood-based Materials	Aliphatic aldehydes (pentanal, hexanal, heptanal, octanal, nonanal, (Z)-2-nonenal, (E)-2-nonenal, formaldehyde), Terpenes
Linoleum	Aliphatic aldehydes (2-alkenals up to C9),
Carpets	Esters (vinyl acetate), Alcohols (1,2-propandiole),
Plastic	Aliphatic ketones (C6–C9) Aliphatic aldehydes (C6–C9) Hydrocarbons (styrene, ¸-methyl styrene), 2-ethyl-1-hexanol
Electronics	Phenols (p-/m/o-cresol)
Household and cleaning agents	Terpenes Aliphatic aldehydes
Human breath	Hydrocarbons (isoprene) Aldehydes Ketones (acetone), Alcohols (ethanol, methanol
Human skin	Organic acids, Sulfanyl alcohols Esters, Aldehydes Hydrocarbons

Source: Burdack-Freitag et al., 2017

6. 5. 1 Sampling of air and extraction of volatile compounds

Bags from plastic material equipped with a sucker, which does not give off scents are usually used for sampling the air. An example of such a bag is on the figure 6.1.

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Figure 6.1 Extraction of volatile compounds to SPME fiber from air sampled to plastic box
Source: Own author´s picture

The solid-phase microextraction (SPME) method is often used for air sampling. This method is one of the newer approaches to extracting substances from various matrices. Its design is undemanding for both time and money thanks to the possibility of reusing of SPME fiber. The method is based on the sorption of an analyte on a special fiber made of various polymers (most often divinylbenzene, polydimethylsiloxane and Carboxen). Two possible methods of application are used, namely DI-SPME (direct immersion SPME), where the fiber is directly immersed in the sample and HS-SPME (head space SPME), where the fiber is in the immediate space above the sample, this method is used in the analysis of air. The amount of HS-SPME substances that are sorbet onto the fiber depends on the equilibrium between the space above the sample and the sample matrix (determined by the dissociation constant K2) and between the fiber and the space above the sample (determined by the dissociation constant K1). The individual equilibrium can be influenced by heating, sample volume and sorption time (Hui, 2010).

6. 5. 2 Gas chromatography in air analysis

Gas chromatography is classified as a separation method. The individual components of a sample are separated from each other on the basis of their different affinities for a stationary, immobile phase. The higher the affinity of the sample components for the stationary phase, the longer these components are retained in the column (Harris – Lucy, 2016).

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The sample is dispensed by a special syringe into a heated injection chamber where it is immediately gassed and entrained as a vapour in a carrier gas or mobile phase stream through a column that is housed in a thermostat. The source of the carrier gas is a cylinder. Nitrogen, helium or hydrogen are used as carrier gases. Nitrogen has the advantage of low cost and high separation efficiency. However, the problem is the very low linear velocity, which causes long retention times. Compared to nitrogen, helium has a higher linear velocity, but the separation efficiency decreases slightly. However, the main disadvantage is its high cost. The efficiency of hydrogen is comparable to helium, but the price of hydrogen is lower. The main disadvantage may be the explosiveness of hydrogen if not handled properly. The individual molecules of the sample split between the stationary and mobile phases and the system approaches equilibrium. Any molecule can bind to the stationary phase, but only as a substitute for another, balanced one. This process maintains equilibrium. The molecules move at different rates in the column according to their representation in the two phases. The detector records the concentration of the separated substances and the graphical record of the entire separation, produced by the recorder, is called a chromatogram. This contains a series of peaks from which the identity of the substance can be determined, and its quantity is determined by the area of the peak. Optimally, the aim of the analysis is a chromatogram in which the peaks are symmetrical, narrow and sharp and do not overlap (Harris, 2016).

The GC-MS (gas chromatography-mass spectrometry) method is based on the separation of substances according to their weight / charge ratio of the molecule. Although this method is destructive, it does not detract from its advantages, which include the speed of analysis and the very small amount of sample required for analysis (Başer – Buchbauer, 2010). Some compounds may be incorrectly identified by the mass detector. Therefore, confirmation using Kovat´s retention index is used in practice, where an unknown substance is evaluated using retention-reduced times (Goodner, 2008). The use of tandem mass spectrometry (GC-MS-MS) is another and often the only way to detect and confirm compounds (Nielsen, 2010) for which the classical GC-MS coupling was not sufficiently selective (Başer – Buchbauer, 2010). Detection of all compounds in the air is a very difficult task. In the case of complex mixtures in conventional gas chromatography, the components may coelute. Typical examples of coelution are limonene and 1,8-cineole or octanal and α-phelandren. Usually, a serial connection of two columns is used, so-called two-dimensional GCxGC chromatography, where the sample passes through separation first on the first column and then it is injected into the second column. These two columns differ in stationary phases. Multidimensional gas chromatography increases the efficiency of the separation process (Başer – Buchbauer, 2010).

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Gas chromatography-olfactometry is a technique for the detection of volatiles where a human is present alongside a detector such as a mass spectrometer or flame ionization detector (Figure 6.2). This person uses a special port to smell the substances coming out of the gas chromatograph column. For each substance, it is possible to determine whether it gives rise to a sensory perception, the duration of the sensory perception, a description of the perception and its intensity. The result of gas chromatography olfactometry is the so-called aromagram. Since the human factor introduces considerable error into this method, it is necessary to adapt the conditions as far as possible so that the analysis is as little affected as possible. For better comfort, humidified air is introduced into the olfactometric port to avoid excessive drying of the mucous membrane and thus reducing the comfort of the evaluator. It is advisable that the analysis is carried out in a clean environment free from extraneous odours and noises. The most common application is in food and beverages, where GC-O can be used to identify characteristic flavour components and any defects in the product (Delahunty et al., 2006).

The following pictures show chromatograms from the air analyses we performed in our laboratory (Figures 6.3–6.4). They show that a wide range of different organic substances are present in the air. These are mainly various hydrocarbons, aromatic compounds and acids.

Figure 6.2 Gas chromatography-olfactometry with mass detector
Source: Own author´s picture

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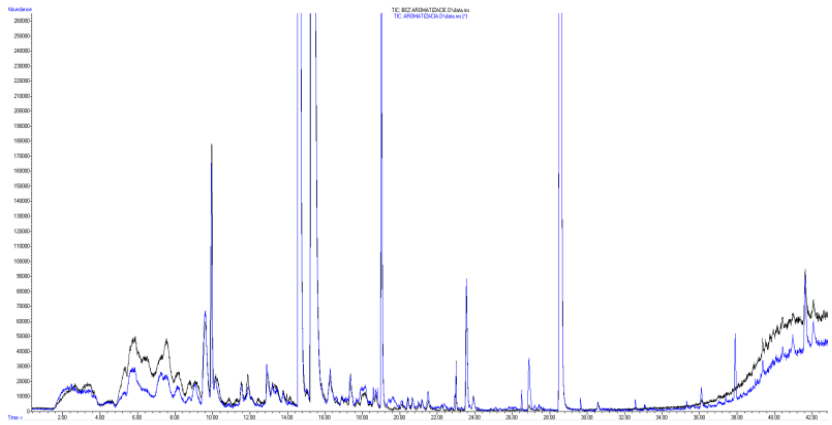

Figure 6.3 Chromatogram with fingerprint of volatile compounds from air. Air from indoor space of industrial factory without scenting (black line) and with scenting (blue line)
Source: Own author´s chromatogram

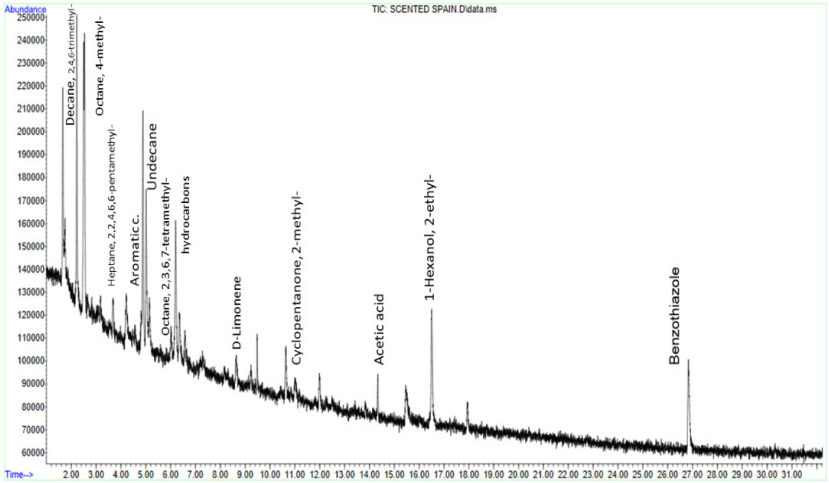

Figure 6.4 Chromatogram with determined volatile compounds from scented air
Source: Own author´s chromatogram

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6. 6 Conclusion

Creating a positive environment for shoppers can be a big advantage for retailers. A pleasant smell seems to be one of the possible circumstances. Our findings may contribute to a better understanding of shoppers' emotions and their behaviour in response to in-store scent. We need to study what can influence people, as it is known that shoppers differ in their sensitivity to smell and the emotions evoked due to, for example, gender, age, mood at the time of shopping or length of time spent shopping.

The use of a pleasant and interesting smell in shops can affect customers who then like to return to the store. They have a smell associated with an interesting experience, etc. However, the choice of smell is very important because the division of smell into pleasant and unpleasant ones is not the same in the population and people may differ in their perception of the same smell. Moreover, the perception of scent is also dependent on concentration and can vary with concentration from very pleasant to unpleasant. Some authors also consider whether too many incentives can have a negative effect.

For analysis of air quality one or multidimensional gas chromatography with mass spectrometry or olfactometry can be used. Some studies use also a highly sensitive photoionization detector (PID).

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