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**INFLUENCE OF OLFACTORY CUES ON MUSEUM
VISITORS' LOCOMOTARY BEHAVIOR**

Master's thesis

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Suunan kaitsmisele

(juhendaja allkiri)

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Abstract

The aim of the research is to quantitatively measure the impact of the olfactory variable (scent) on the behavioral patterns (movement trajectory) of the experiment subjects (museum visitors) within controlled unstructured environment thus reducing the existing research gap on potential influence of fragrances on human locomotory behavior. A field study with 244 participants showed a noticeable difference in both locomotory behavior and general behavior of visitors after the introduction of the scent into the museum environment. Impact was measured by observing changes in trajectory of movement and behavior of museum visitors, which was visualized using spaghetti diagrams. In addition, the distinctive difference in the behavior of female and male subjects was recorded. Results of the research might be helpful to store managers, museum and gallery curators to help create pleasant atmospherics within the environment and guide visitors to certain points of interest or via certain routes within both retail and non-retail environments.

Keywords: ambient scent, museum atmospherics, olfaction, customer behavior, gender differences

Introduction

Retailers are constantly looking into various ways to influence behavior of their customers to make them buy the advertised product or to make them pay more for the certain product without feeling bad about the purchase. A synthesis of the recent literature by Peighambari et al. (Peighambari, Sattari, Kordestani, & Oghazi, 2016) shows a constant growth in interest towards consumer behavior research. The consumer neuroscience is blooming in finance, management and marketing. These areas have seen a significant increase in the use of experimental methods that measure physiological and/or neural signals (Karmarkar & Plassmann, 2019). With the rise of the behavioral sciences more such influences will be introduced into everyday life.

Multiple stimuli addressing various human senses can be used as effective marketing instruments. Colors (Cho & Lee, 2017), sounds (Lowe & Haws, 2016) and fragrances (Madzharov, Block, & Morrin, 2015) alone or in combinations (Hagtvedt & Brasel, 2015; Yang & Chen, 2015) all can be used to motivate and influence human behavior. Scent is often unnoticed or overlooked, but at the same time it plays an important role in social life. It can consciously and unconsciously influence how people perceive each other, products they purchase and places they visit (Homan et al., 2017). Various experiments have been conducted over the years to research the in-store atmospheric effects of different stimuli including the impact of fragrances on human behavior and emotional state (Roschk, Loureiro, & Breitsohl, 2017). But no research, to authors knowledge, has been done to specifically study the impact of olfactory cues on human locomotory behavior. Some authors have observed and mentioned the effect (Doty, 1986; Doucé, Poels, Janssens, & De Backer, 2013; Helmfalk & Hultén, 2017) but no extensive research has been done so far.

The aim of current research is to quantitatively measure the impact of the olfactory variable (scent) on the behavioral patterns (movement trajectory) of the experiment subjects (museum visitors) within controlled unstructured environment thus reducing the existing research gap in

potential influence of fragrances on human locomotory behavior. Overall, research of the influence of olfactory cues on consumer behavior falls under sensory marketing research, which is an element of experiential marketing (Schmitt, 1999). Museum was chosen as a primary location for the observation because of being perfect experimental environment without distractions specific to retail environments including the fact that visitors in general do not purchase any products during the tour.

The impact of olfactory cues on visitors of museums, art galleries, art shows and exhibitions is not a researched topic. In such environments people do not purchase items directly, but they spend their money on admission fees and accompanying services and expect to get emotional satisfaction from the visit to such places. In case of commercial art galleries pleasant experience from the visit can lead to purchase of the art piece showcased in the exhibition. In case of museums with free admission it can lead to donations and patronage (Alcaraz, Hume, & Mort, 2009; Jeong & Lee, 2006). Consequentially, providing pleasant experiences during the visit is of utmost importance while setting up the exhibition or organizing a museum tour. Museum visitor routing problem (Yu, Lin, & Chou, 2010) can become an obstacle to getting pleasant experience. Improper routing with addition of other factors can lead to boredom, loss of interest and attention and overall decline in satisfaction from the visit (Antón, Camarero, & Garrido, 2018; Ruiz-Alba, Nazarian, Rodríguez-Molina, & Andreu, 2019; Sheng & Chen, 2012). Leading visitors through the exhibition following a certain route with the help of olfactory cues can be one of the aiding factors in retaining the pleasant experience from the visit.

Conceptual Framework

Scent and human behavior

Several different researches, including the one done by Ariely and Norton (Ariely & Norton, 2009) showed that consumer behavior is very fluent. Consumers' individual psychological associations and cognitive concepts can alter or even override the physical sensory consumption experience (Plassmann & Weber, 2015). Stimulus-Organism-Response paradigm by Mehrabian and Russell (Mehrabian & Russell, 1974) is widely used as a theoretical basis for research of the consumer behavior within the retail environment.

Stimulus-Organism-Response (S-O-R) model states that in reaction to some stimulus within the environment people react with either approach or avoidance behaviors based on personal internal evaluations. Model suggests that any surrounding environment always produces an emotional condition within the person, describable by three following states/dimensions: pleasure-displeasure (level of enjoyment and gratification), arousal-nonarousal (level of physical activity and mental alertness) and dominance-submissiveness (feelings of control versus lack of control over person's activities and surroundings).

According to S-O-R model scent is one of the sense modality variables triggering primary emotional responses influencing the overall behavior of the person and consequently can be used as an appropriate marketing tool influencing the purchase behavior of consumers. Figure 1 below illustrates the generalized view of the Stimulus-Organism-Response (S-O-R) model proposed by Mehrabian and Russell.

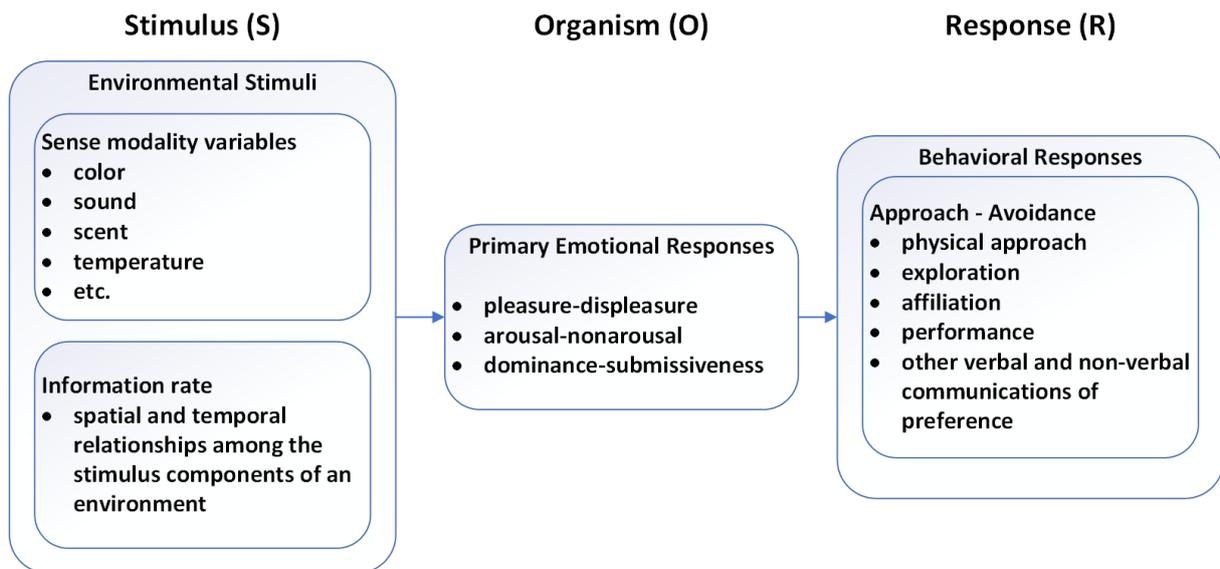


Figure 1. Stimulus-Organism-Response (S-O-R) model by Mehrabian and Russell (image by author based on (Mehrabian & Russell, 1974))

As a confirmation to previous research and S-O-R model, research by Gulas and Bloch (Gulas & Bloch, 1995) proved that introduction of a pleasant scent can lead to a positive affective and cognitive responses. In support of these findings a field experiment done by Douce and Janssens (Douce & Janssens, 2013) showed that a pleasant fragrance positively influences consumers' affective reactions, evaluations, and intentions to revisit the store. Overall, meta-analysis of 30 years of experimental research of the atmospheric in-store stimuli by Roschk et al. (Roschk et al., 2017) confirms that olfactory cues can be used as a reliable instrument to improve shopping experience and influence consumer behavior.

Use of fragrances in marketing has many dimensions and forms. One way to utilize fragrances in retail environment is in a form of an ambient scent. Ambient scent refers to a scent that is not salient and cannot be associated with any specific product in the environment and is perceived as a part of the environment. Multiple experiments have been done to evaluate the effectiveness of olfactory cues specifically ambient scent in marketing. As an example, experiments done by Seo et al. (Seo, Roidl, Müller, & Negoias, 2010) proved that ambient scent is one of the influencing factors on consumers' shopping behavior. Research by Madzharov et al. (Madzharov et al., 2015) demonstrated that in a warm-scented and thus perceptually more socially dense environment, people experienced a greater need for power, which manifested in increased preference for and purchase of premium products and brands. Opposite affect for cool-scented and thus less socially dense environment was observed. All in all research done in this area provides a solid foundation to make the assumption that ambient olfactory cues can be used to influence consumer behavior and S-O-R paradigm can be utilized as a theoretical basis for an experimental setup for investigation.

It should be mentioned that the use of fragrances as marketing instrument is not fully officially regulated and has its own debatable limitations. Bradford and Desrochers in their work (Bradford & Desrochers, 2009) bring to the surface some ethical implications and aspects related to using scent in marketing industry. These implications include influencing consumer buying behavior without consumers consent, covertly persuading consumers to purchase products using ambient scents, creating marketing stimuli that persuade consumers without

their knowledge and making claims regarding fragrance products that are unfounded and may mislead customers. On the other hand, in recognition of possible influence on health and in response to early concerns about fragrance allergies, fragrance industry and regulatory institutions established a set of regulations and practices governing the use of scents and associated products. Such regulations include European Union Regulation 1223/2009, International Fragrance Association (IFRA) Code of Practice, EU Registration, Evaluation, Authorisation and Restriction of Chemicals regulation (REACH), Leadership in Energy and Environmental Design (LEED) certification, advisory documents by European Union Scientific Committee on Consumer Safety (EU SCCS) and Research Institute for Fragrance Materials (RIFM), regulatory acts by United States Occupational Safety and Health Administration (OSHA) and others.

Moving aside from ethical implications, it should be noted that purchasing process, in the form of buying an item or receiving a service, is a wholesome experience for a person. Scent by itself is just one of the influencing factors, when combined with other visual or audial factors it may help to influence consumer behavior more substantially. As an example, in research performed by Yang and Chen (Yang & Chen, 2015), authors found out that majority of experiment subjects in perfume store chose different scents when solely relying on sight or sense of smell. Visual properties of products influenced the choice more than olfactory cues during the experiment. Scent was not the predominant influencing factor, but for many participants it was an important one.

There are multiple factors that need to be acknowledged when using olfactory cues. Perception of scents is a subjective experience (Agapakis & Tolaas, 2012). Some scents can be pleasant to one person and totally disgusting to another. Cultural context and individual environment around the person play a significant role in smell perceptions. Exposure to certain aromas from an early age can lead to pleasant emotions and associations related to these aromas or it can produce negative emotions from the same olfactory cues in another person with different experience and cultural background (Barwich, 2017; Kastanakis & Voyer, 2014; Sandell, Hoppu, & Laaksonen, 2018; Secundo, Snitz, & Sobel, 2014). There are many additional attributes that need to be considered when using olfactory cues in marketing research. For example, Hermann et al. (Herrmann, Zidansek, Sprott, & Spangenberg, 2013) as a part of their research looked at difference between simple, complex and no scent conditions. Results showed that the presence of simple ambient scent had more significant impact on shopping behavior in comparison to similar complex smell or no scent at all. Another additional influencing factor in subjective perception of the scent is the appropriateness of the olfactory cue to the product, situation or surroundings. The situation when scent matches or contradicts the environment or product perception is called congruency effect (Gulas & Bloch, 1995).

It can be safely concluded, that substantial body of research on influence of olfactory stimuli on human behavior provides a solid foundation and evidence that fragrances and specifically ambient olfactory cues can be used as a marketing instrument within retail and non-retail environments, taking into account certain ethical limitations. Additionally, predictions of the S-O-R model should be used as a theoretical basis for an experimental setup to investigate the impact. Aside from ethical limitations, it should not be forgotten, that multiple aspects need to be accounted for when setting up the experiment or using fragrances for marketing, one of them being congruency effect which will be discussed in detail in the next chapter.

Congruency effect

Congruency effect refers to the fact that during process of finding a solution to a forced choice task, stimuli and corresponding responses can either overlap or not, producing either positive or negative results. Congruency effect arises when relevant stimuli overlap with response dimensions which leads to positive effect, like faster response times. When irrelevant stimuli overlap with responses (stimulus and response features are incongruent) a negative result is observed (Egner, 2007).

As mentioned previously, according to Stimulus-Organism-Response paradigm (Mehrabian & Russell, 1974) in case of ambient scent, introduction of a pleasant scent can lead to a positive affective and cognitive responses. But to achieve positive effect a scent must be not just pleasant but also relevant to the situation and a person making a choice. Ambient scent model defined by Gulas and Bloch (Gulas & Bloch, 1995) states that congruency between ambient scent in the store and store offerings can lead to a positive change in consumer behavior, such as increase in consumption or higher satisfaction with provided service. In the research by Douce et al. (Douce et al., 2013) authors showed that introduction of the smell of chocolate in a book store lead to significant impact on consumer behavior. Authors observed that after the introduction of the smell of chocolate when compared to control condition customers were almost six times more likely to purchase congruent books (books for which smell of chocolate was relevant and produced a positive association, i.e., romantic literature and cookbooks). On the other hand, in case of incongruent books it led to a negative effect in customers approach and purchasing behavior.

Identical scent can produce different behaviors in different people in similar situation. For some a certain scent will make them stay longer in the shop or make them buy a certain product. For others, the same scent in the same shop will have either no effect or even a negative effect. Gender plays an important part in the perception of the sent and accompanying reaction. There is an undoubtful difference in how women and men perceive fragrances and which aromas they prefer or find more attractive. As an example, the research by Douce et al. (Douce et al., 2013) showed that women were more susceptible to smell of chocolate than men, which led to a higher purchase of congruent books by women in the same environment. Stephan Jellinek (J. S. Jellinek, 1997) in his book on odor effects and the psychological basis of perfumery also discusses different gender specific aspects of scent perception. As another example the study by Zarzo and Stanton (Zarzo & Stanton, 2009) on the underlying dimensions in perfumers' odor perception space utilize gender related terminology such as feminine and masculine fragrances and feminine and masculine odor character descriptors to highlight the differences in perception and to construct the low-dimensional perceptual maps of fragrances.

Saliency of the scent is another influencing factor, that need to be accounted for. Olfactory cues can have an influence on the behavior both when the ambient scent is salient and not. Kechagia and Drichoutis (Kechagia & Drichoutis, 2017) in their research showed that introduction of citrus smell substantially increased overall willingness to pay for a product but had no influence on risk aversion. During the experiment authors observed a differential effect of conscious and unconscious perception of aromas for congruent and incongruent items (food and non-food items). For congruent item subjects had to be aware of the smell and for incongruent item both supraliminal and subliminal perception of scent had its effect on behavior. Results are in part contradictory to earlier experiments due to many factors such as experimental setup, congruency of the scent to experimental objects and the fact that ambient smell in case of food

item could be directly associated with the item and thus move to a product-specific scent category and be recognized by participants which had its effect on associated behavior. In comparison, earlier study by Bosmans (Bosmans, 2006) revealed that when ambient scent is congruent to the product or environment it impacts subject's behavior even when the scent is noticeable or when study subjects are motivated to discount the influence. Scent that is incongruent with the product could still influence consumer behavior when the scent was not salient, or subjects were not aware of the possible influence. Study showed that subjects were not influenced by ambient scent only in case when the scent was completely incongruent with the product. Congruency effect can also be observed in combination of different sensory cues. Helmefalt and Hulten (Helmefalt & Hultén, 2017) showed that combination of multiple congruent stimuli (visual, audio and olfactory) can have bigger effect on purchase behavior and emotional reactions in comparison to each stimuli alone. Research showed sizable impact of multisensory congruent cues on valence, time spent and overall purchasing behavior of customers at the store.

In relation to other sensory cues, research suggests that olfactory cues are processed in more ancient, more primitive portion of the brain (Doty, 2017; Engen, 1982). Sense of smell and associated ability to register various scents is one of the evolutionary instruments, it helps to locate food, find mates, detect predators and thus greatly improves fitness. Based on the examples of research mentioned previously it can be concluded that to achieve positive effect as a marketing instrument a scent must be not just pleasant but also relevant to the situation and a person making a choice. Congruent scents can produce significant impact on consumer behavior. As discussed in the introduction, one of the ways to use olfactory cues in order to improve the experience is to guide the consumer to certain location within the environment with the help of an aroma, congruent to the surroundings and situation, that creates a pleasant associations within the brain of the consumer and increases the overall satisfaction and feeling of joy for the subject. This approach will be discussed in detail in the following chapter.

Olfactory-induced locomotory behavior

In line with aforementioned Stimulus-Organism-Response paradigm proposed by Mehrabian and Russell (Mehrabian & Russell, 1974) it can be said that a scent that gets associated in the brain with something pleasant lures humans or animals to its source and scent that is associated with something bad or dangerous scares them away. Humans when they feel a pleasant aroma enjoy it and seek out the source. It is like smelling flowers, when a likeable floral scent is detected, a person usually steps closer and smells the flower directly. Overall, people enjoy being surrounded by pleasant aroma and it evokes positive emotions within them, increasing the joy. At the same time when a person smells something bad, like smell of decay, a person tries to cover the nose to stop the smell from entering further and then tries to leave the area with unpleasant odor as soon as possible.

As shown by examples of research mentioned in previous chapters, sense of smell has great influence on human emotions and directly impacts associated human behavior. As it was mentioned previously, research of the influence of aromas on human behavior falls under sensory marketing research, an element of experiential marketing. It is important to note that in experiential marketing consumers are considered to be rational yet emotional subjects that like to encounter pleasant experiences (Schmitt, 1999). The approach-avoidance behavior described

in the beginning of the chapter and associated urge to go to the source of the pleasant smell reinforce the hypothesis that scent can be used as an instrument to influence the locomotory behavior of subjects within the environment.

Based on prediction of the Stimulus-Organism-Response paradigm presented above it can be suggested that pleasant congruent smell will (1) lure people to its source and (2) by increasing the number of pleasant experiences induced by the scent the overall customer satisfaction can be increased. In support to first hypothesis the experiment by Douce et al. (Douc e et al., 2013) showed a significant effect of the ambient scent on general approach behavior and a negative influence on goal-directed behavior.

Figure 2 illustrates the proposed approach based on Stimulus-Organism-Response (S-O-R) paradigm where it is presumed that after the introduction of a congruent low intensity pleasant scent, it is expected that it will produce pleasure and arousal responses within the subject that will lead to physical approach to the source of the scent or exploration of the area of scent diffusion.

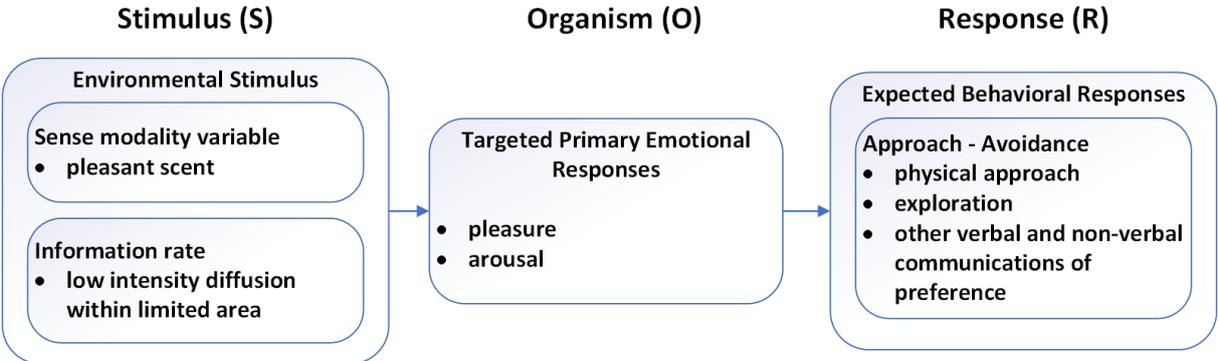


Figure 2. Adjusted Stimulus-Organism-Response (S-O-R) model depicting introduction of a pleasant scent and associated targeted emotional response and expected behavioral responses (image by author based on (Mehrabian & Russell, 1974))

The experiment by Douce et al. (Douc e et al., 2013) mentioned above was conducted within the retail environment, but findings suggest that the same approach could be extrapolated to non-retail environments such as museums and art galleries. Museum visitors do not purchase any goods directly, but they expect to get emotional satisfaction from the visit. Taking into account museum visitor routing problem (Yu et al., 2010) mentioned in the introductory part of this article it can be suggested that leading visitors through the exhibition following a certain route with the help of olfactory cues can be one of the aiding factors in retaining the pleasant experience from the visit.

The reasoning presented above and predictions of the Stimulus-Organism-Response paradigm lead to the following hypothesis that is the primary focus of the current study:

H: museum visitors can be guided from the main path for visitors to an alternative path leading to a certain point of interest by introducing an olfactory cue congruent to museum environment and proposed point of interest.

Method

Environment

The study, comprising of two experiments with observations, was conducted on the premises of the maritime museum within in-doors environment. Museum was chosen to be a main location for experimentation as it represented a non-retail environment clean of distractions specific to retail environments including advertising materials and other in-store atmospheric stimuli, thus allowing to measure influence of a specific olfactory cue.

Primary area of the exhibition hall of the museum is a multi-level open space under columnless thin-shell concrete domes. Museum visitors start their visit in the lobby of the museum, where ticket office, wardrobe, restrooms and museum store are located. Lobby is equipped with multiple large screens, that constantly show museum related pictures and exhibition information. From the lobby visitors move to the second floor of the museum, go through the ticket gate and continue the visit along the elevated pathway. Main route for museum visitors starts on the second floor of the museum, continues along the elevated pathway circling around the center of the exhibition space and progresses down to the main floor exhibition area. Elevated pathway is equipped with auxiliary staircases leading to the main floor of the museum.

A new temporary exhibition in the northern part of the main floor was recently installed prior to the experiment. Main theme of the exhibition was the desire and longing of seamen. During the study, the new exhibition was used as a point of interest for museum visitors. The hypothesis to validate during the experiment was refined to:

H: museum visitors can be guided from the main visitors path to an alternative path leading directly to the new exhibition by introducing an olfactory cue congruent to museum environment and the main theme of the exhibition (sex and the sea).

The area on the elevated pathway in the north-west corner of the building where main visitors route and a route to auxiliary staircase splits was chosen for the experiment. Figure 3 illustrates the location chosen for the study. Left portion of the illustration depicts the schematic view of the area from above and on the right an actual view from the point of view of museum visitors is shown. Alternative path along the auxiliary staircase leads downstairs directly to the new exhibition area mentioned above.



Figure 3. Experimental environment. Schematic view from above is on the left and actual view from the point of view of experiment participants is on the right (image by author)

Main path for visitors was equipped with pointers and was well lit by lamps. Alternative route had no signs and lights were dimmed in the area. Alternative path had a slight curve to the right hiding behind the closed bridge. The environment remained unchanged during the study.

Design and procedure

Data reflecting locomotory behavior of participants of the field study was gathered using A/B experimentation technique. A field study was split into two separate observations within the same environment. During experiment A locomotory behavior of subjects under study was observed in the undisturbed controlled environment with no additional olfactory stimuli introduced. Research team visually observed and recorded movement trajectories of experiment participants.

Experiment B was organized in the way that maximized similarities of conditions to the first experiment. It occurred on the same day of the week and around same time of the day to eliminate any possible discrepancies in the environment. During experiment B a stimulus in a form of a scent was introduced with the goal to influence the movement trajectory of research subjects. Flow chart of the experiment B setup is illustrated on Figure 4 below. In order to ensure positive mental association of the scent to the exhibition during experiment B initial scent-exhibition congruency creation was done in the lobby of the museum along the main route to the exhibition. Exhibition promotional video was displayed on a set of two large screened TVs located in the space near the cash desk and wardrobe. Scent diffuser was installed in the area hanging from the ceiling. The idea was to expose museum visitors looking at promotional video to the scent and create mental association between the aroma and the exhibition. Second scent diffuser was placed high on the lamp post located along the alternative path illustrated on the Figure 3. Scent diffusion was calibrated in a way that the scent could be felt in the point of the split between main and alternative paths.

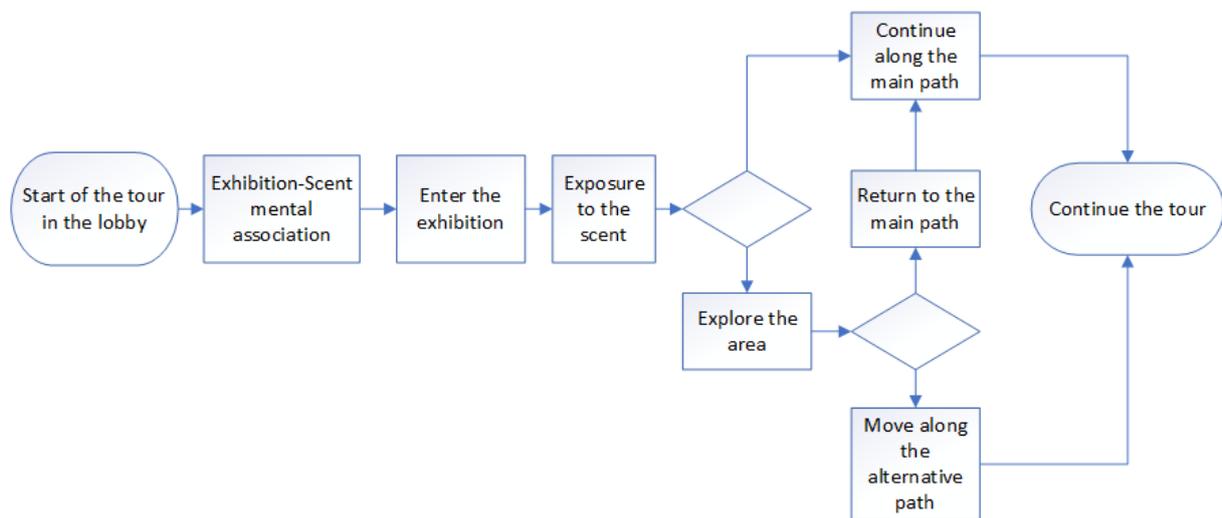


Figure 4. Flow chart of the experiment B setup (image by author)

Behavioral data and locomotion patterns during both experiments A and B were gathered, classified and analyzed. Locomotion trajectories were visualized using spaghetti plots (Allen, 2010). As a part of this technique individual trajectories of each experiment subject were superimposed onto each other, producing the illustration of dominating path or paths used by majority of museum visitors. As a result, various distinctively dominating locomotion patterns could be separated and analyzed.

Participants

Locomotor behavior of 244 museum visitors in total was observed during the research. The sample consisted of both women and men of various ages. Overall, movement trajectories of 131 women and 113 men were observed during two observation sessions. During the experiment museum visitors moved along the route either individually or in small groups usually consisting of couples, larger family members or friends. During first observation without the scent trajectories of 122 people (57 women and 65 men) were recorded. During second observation after the introduction of the olfactory cue trajectories of additional 122 people (74 women and 48 men) were recorded. The research was structured to be as inconspicuous to museum visitors as possible. Participants were not specifically chosen and were not aware of the experiment prior to observation. Interviews were conducted during two pretests to help define the congruent scent and to validate the saliency of the scent the day before the final experiment. No interviews were conducted during the final observation.

Stimuli

In previous chapters it was discussed that the perception of scents is a subjective experience. It can differ based on cultural, environmental and individual experience related factors. When choosing the appropriate scent for the experiment and analyzing its properties all these factors needed to be taken into consideration. Chosen scent should have been attractive, culturally acceptable and situationally relevant. It should have triggered pleasant emotions and associations in majority of subjects of the experiment. The scent should have been congruent to the environment and purpose of the research and should have been neither too weak, so that subjects would not feel it, nor too strong to trigger negative reactions.

To minimize possible ethical issues highlighted by Bradford and Desrochers (Bradford & Desrochers, 2009) instead of covert objective ambient scent, detectable objective ambient scent was used. To avoid any harm or potential health risks, a reputable multinational company with proven track record of successful partnerships with various businesses was chosen as a partner to provide scents and the setup for scent diffusion. All the scents and equipment used during the experiment complied to strict requirements and regulations and were certified. Fragrances used during the experiment did not contain any phthalates, volatile organic compounds and were safe for humans, animals and the environment.

The choice of the scent that would be congruent to the museum environment and theme of the exhibition was based on the previously mentioned research of underlying dimensions in perfumers' odor perception space by Zarzo and Stanton (Zarzo & Stanton, 2009) and earlier research by Jellinek (J. S. Jellinek, 1997). A variety of various scents was examined and a sample group of five specific scents was chosen. Sample set was based on multidimensional sensory odor map by Zarzo and Stanton and was aimed at covering a spectrum of opposite pairs (erogenous vs. anti-erogenous, narcotic/sweet vs. stimulating/bitter). First scent represented erogenous and narcotic/sweet dimensions, second scent represented anti-erogenous and narcotic/sweet dimensions, third scent represented anti-erogenous and stimulating/bitter dimensions, fourth and fifth scents represented erogenous and stimulating/bitter dimensions with fourth scent being more stimulating/bitter and fifth scent more erogenous, rich and woody. Figure 5 illustrates the relative position of the chosen scents on the multidimensional sensory odor map by Zarzo and Stanton.

Results

During the experiment A initial observation of 122 people (57 women and 65 men) revealed three distinct locomotion patterns. The upper left quadrant of the Figure 6 below illustrates a resulting spaghetti diagram for the experiment A, other three quadrants of the illustration depict three distinct patterns that were identified during the observation.

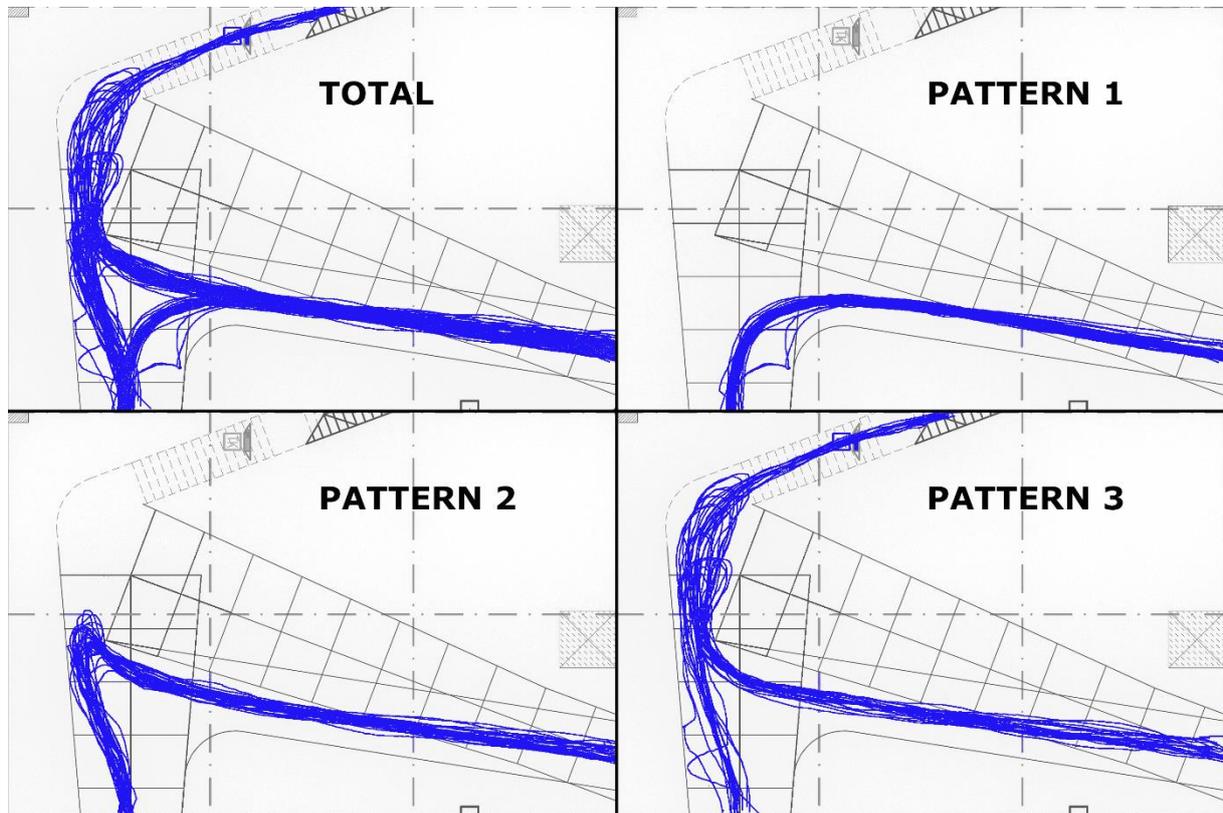


Figure 6. Spaghetti diagrams for the experiment A. No olfactory cues introduced (summary plot in the upper left corner and three distinct patterns separately) (image by author)

Figure 6 Pattern 1 illustrates trajectories of museum visitors going along the main route to the exposition. In total 64 (52.46% of total) participants of the first experiment chose this route during the initial observation (29 (50.88% of total) women and 35 (53.85% of total) men).

Figure 6 Pattern 2 depicts trajectories of museum visitors who by one or another reason went to the edge of the bridge deviating from the main route, but then turned back and headed along the main route to the exhibition. In total 31 (25.41% of total) participant moved along this route during the initial observation (15 (26.32% of total) women and 16 (24.61% of total) men).

Figure 6 Pattern 3 represents trajectories of participants who deviated from the main route and either explored the alternative path and returned to the main path or moved down the stairs to the exhibition following the alternative route. Altogether 27 (22.13% of total) participant moved along this route during the initial observation (13 (22.80% of total) women and 14 (21.54% of total) men). All in all, 13 (10.65% of total) visitors moved down the stairs and followed alternative route to the exhibition below during the experiment A (7 (12.28% of total) women and 6 (9.23% of total) men).

During the second experiment (experiment B) 122 people (74 women and 48 men) were observed. Figure 7 illustrates a set of spaghetti diagrams resulting from the observation. Similar to previous figure, the upper left quadrant of the Figure 7 illustrates a resulting spaghetti diagram for the experiment B, other three quadrants of the illustration depict three distinct patterns that were identified during previous observation.

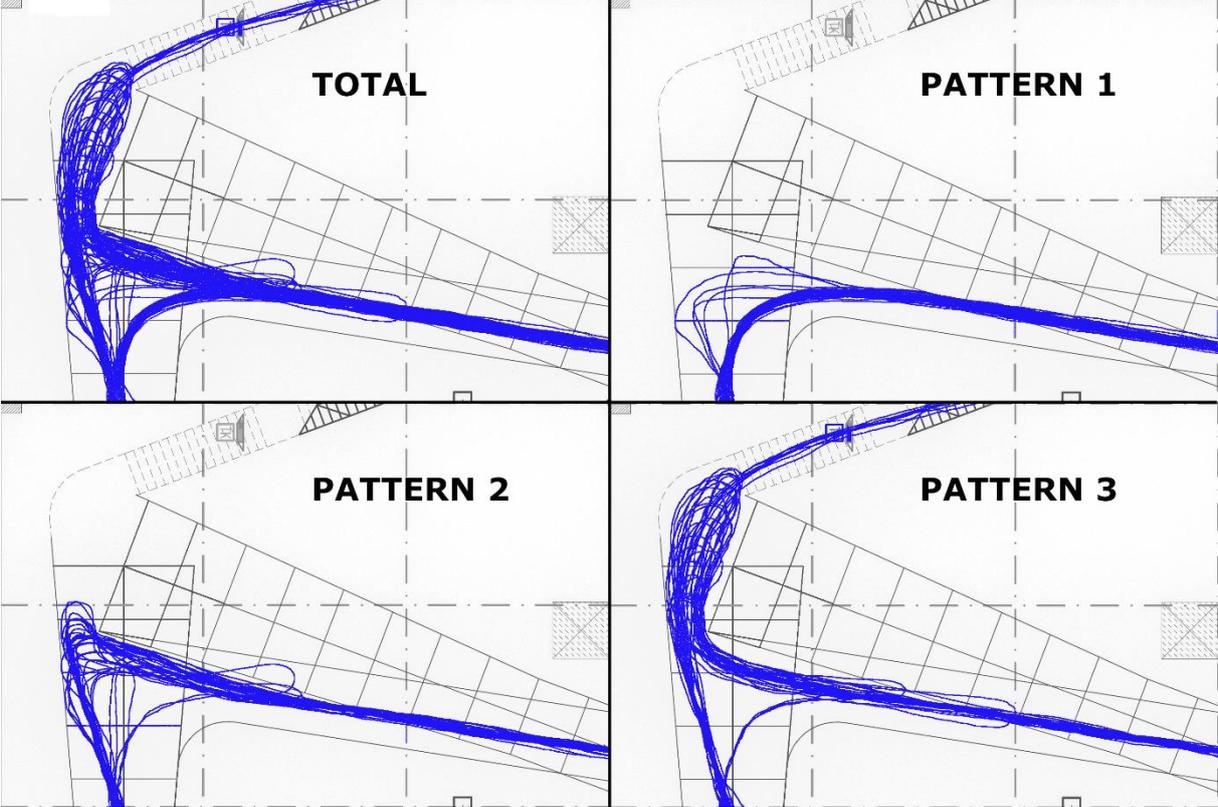


Figure 7. Spaghetti diagrams for the experiment B after introduction of olfactory cue (summary plot in the upper left corner and three distinct patterns separately as on previous figure) (image by author)

Similar to previous figure, Figure 7 Pattern 1 illustrates trajectories of museum visitors following the main path to the exposition. In total 61 (50.00% of total) participants of the second experiment chose this route during the observation (39 (52.70% of total) women and 22 (45.83% of total) men).

Figure 7 Pattern 2 depicts trajectories of 30 (24.59% of total) museum visitors observed during experiment B (13 (17.57% of total) women and 17 (35.42% of total) men) who went to the edge of the bridge deviating from the main route, but then turned back and followed the main path to the exhibition.

Trajectories of 31 (25.41% of total) museum visitors (22 (29.73% of total) women and 9 (18.75% of total) men) who explored the alternative path and then either returned to the main path or moved down the stairs to the exhibition are represented by Figure 7 Pattern 3. Out of this set of participants 8 (6.56% of total) visitors (6 (8.11% of total) women and 2 (4.17% of total) men) moved down the stairs.

Table 1 below summarizes data and presents overall results gathered during both observations. Data in Table 1 represents the distribution of all museum visitors observed during both

experiments between three distinct locomotion patterns. Data in column Pattern 1 represents museum visitors following the main route to the exposition. Data in column Pattern 2 represents museum visitors who went to the edge of the bridge, but then turned back and headed along the main route to the exhibition. Data in column Pattern 3 represents the number of participants who deviated from the main route and either explored the alternative path and returned to the main route or moved down the stairs to the exhibition following the alternative path.

Table 1. Experimental data representing the distribution of visitors between three distinct locomotion patterns during both experiments

	Pattern 1	Pattern 2	Pattern 3	Total
Experiment A	64 (26.23%)	31 (12.70%)	27 (11.07%)	122 (50.00%)
Experiment B	61 (25.00%)	30 (12.30%)	31 (12.70%)	122 (50.00%)
Total	125 (51.23%)	61 (25.00%)	58 (23.77%)	244 (100.00%)

Comparison of numerical data of two observations shows that after the introduction of the olfactory cue 1.23% less of total number of participants of both observations followed the main route to the exposition (pattern 1) and did not deviate from it even after the exposure to the fragrance. In total, 1.63% more participants chose to explore alternative path (pattern 3) and 0.40% less participants chose to move just to the edge of the bridge and then return to the main path (pattern 2) after being exposed to the olfactory cue. Numerically represented total difference in locomotory behavior is comparatively small, but a definite gender related variation in locomotory and general behavior was noticed and recorded during the observation. To highlight and analyze the observed variation overall results were split in accordance to gender and presence of olfactory stimuli and presented below in Table 2 for experiment A (without the olfactory cue) and Table 3 for experiment B (with the olfactory cue).

Table 2 represents data gathered during the first observation. Data in Table 2 provides the distribution of women, men and total number of visitors between three distinct locomotion patterns (122 people in total (57 women and 65 men)). Similar to Table 1 columns Pattern 1, Pattern 2 and Pattern 3 present the number of visitors moving along three specific paths described previously. Data is presented in the form of a numerical value representing the number of visitors moving along the certain path and a percentage value in parentheses. It should be highlighted that percentage value in parentheses represents a percentage out of total number of women or men observed during the experiment A (122 people in total) unlike the percentage value presented previously in Table 1 where a total number of participants of two observations (244 people in total) was taken as a basis for calculation.

Table 2. Experimental data representing the distribution of women, men and total number of visitors between three distinct locomotion patterns during the first experiment

	Pattern 1	Pattern 2	Pattern 3
Women	29 (50.88%)	15 (26.32%)	13 (22.80%)
Men	35 (53.85%)	16 (24.61%)	14 (21.54%)
Total	64 (52.46%)	31 (25.41%)	27 (22.13%)

Table 3 provides data gathered during the second experiment. Similarly to Table 2 data in Table 3 represents the distribution of women, men and total number of museum visitors between three distinct locomotion patterns during the second experiment after the introduction of the olfactory cue (122 people in total (74 women and 48 men)).

Table 3. Experimental data representing the distribution of women, men and total number of visitors between three distinct locomotion patterns during the second experiment after the introduction of the olfactory cue

	Pattern 1	Pattern 2	Pattern 3
Women	39 (52.70%)	13 (17.57%)	22 (29.73%)
Men	22 (45.83%)	17 (35.42%)	9 (18.75%)
Total	61 (50.00%)	30 (24.59%)	31 (25.41%)

By comparing data in Table 2 and Table 3 significant difference in locomotory behavior of female and male participants after the introduction of the scent can be noted. After scent diffusion 1.82% more women chose the main route (pattern 1), at the same time 6.93% more women moved along the alternative path (pattern 3). This difference is compensated by 8.75% less women choosing the midway trajectory (pattern 2). In case of men 8.02% less male participants moved along the main route (pattern 1) and 2.79% less men chose the alternative route (pattern 3). At the same time 10.81% more male participants followed the midway path (pattern 2). The data implies that the change in locomotory behavior of female and male participants after the introduction of the olfactory cue is diametrically opposite. To more clearly illustrate the data Table 4 provides the percentage difference between two observations based on gender differences in locomotory behavior.

Table 4. Representation of percentage difference between experiment A and experiment B based on gender differences in locomotory behavior

	Pattern 1	Pattern 2	Pattern 3
Women	$\Delta +1.82\%$	$\Delta -8.75\%$	$\Delta +6.93\%$
Men	$\Delta -8.02\%$	$\Delta + 10.81\%$	$\Delta -2.79\%$

The change in locomotory behavior can be interpreted as follows: after the introduction of olfactory cue more women (in comparison to situation without the scent) decided not just to explore the area but to go further to find the source due to pleasant associations created by congruent fragrance or skipped the area completely due to either not noticing the scent or incongruency of the scent. At the same time, after exposure to the scent more men decided to explore the area, but after not seeing the source of the scent or associated point of interest (exhibition below was not visible from mid-point at the base of the bridge) they turned back and headed along the main route to the exhibition. In addition to numbers mentioned above, during the second observation (experiment B) a set of unique trajectories was recorded that were not observed during the first experiment. Figure 8 illustrates these unique trajectories. Summary plot is in the upper left quadrant of the illustration and three distinct patterns separately in other quadrants as on previous figures.

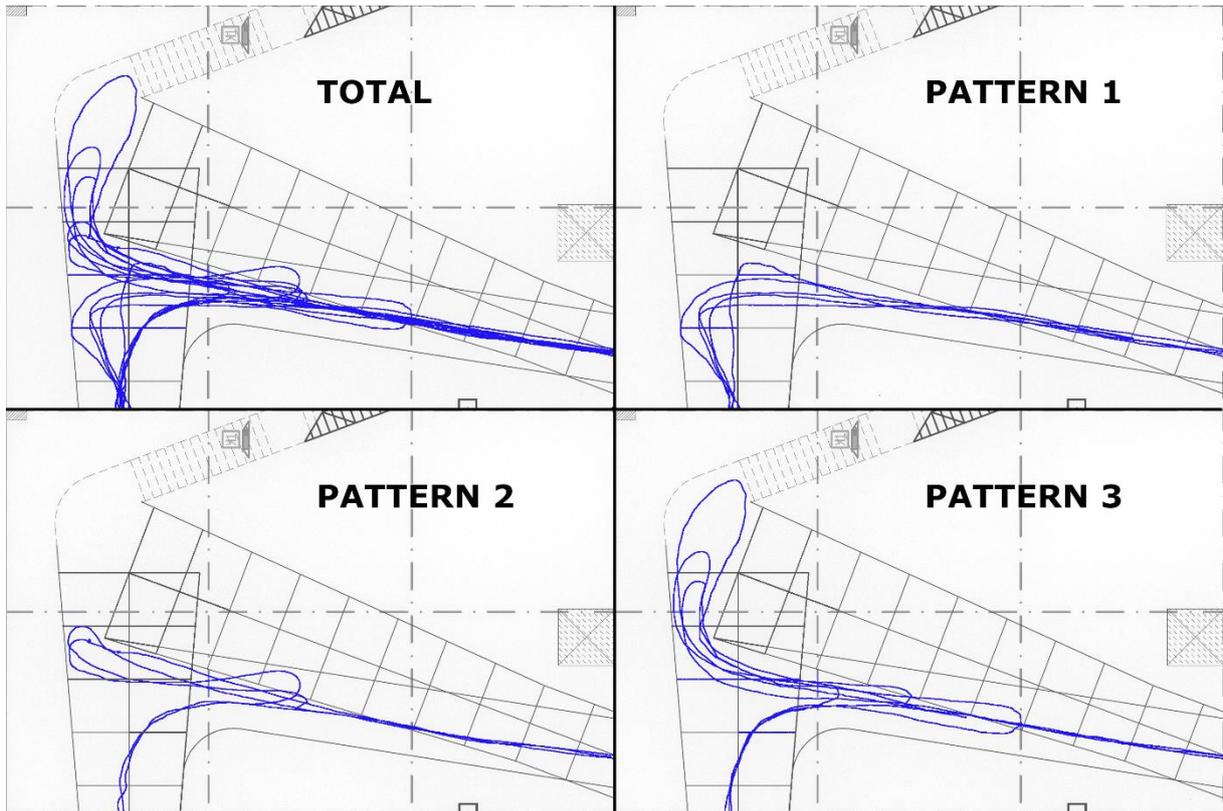


Figure 8. Unique trajectories recorded during second observation (summary plot in the upper left corner and three distinct patterns separately as on previous figures) (image by author)

As can be seen from Figure 8 some museum visitors who moved along the main route deviated slightly to the left after being exposed to the scent and spent more time in the area with the scent (illustrated by pattern 1 trajectories in the upper right quadrant). Two participants moved along the main path to the exhibition but then turned back and walked to the edge of the bridge, to explore the area with the scent (illustrated by pattern 2 trajectories in the lower left quadrant of Figure 8). Three participants who initially moved along the main path, at some point turned back and moved along the alternative path and explored the area filled with the scent (illustrated by pattern 3 trajectories in the lower right quadrant of the figure below).

In addition to unique trajectories captured during the observation a significant difference in behavior of participants of the second experiment was observed. A noticeable number of museum visitors after the exposure to the olfactory cue slowed down their step and spent more time overall in the area where scent was diffused. Majority of participants who either moved to the edge of the bridge (pattern 2) or explored the alternative path (pattern 3) spent considerably more time in the area with the scent in comparison to participants of the first experiment.

Distinct behavioral pattern that cannot be deduced from plots presented above was observed additionally in participants who moved along in pairs or small groups. They stopped in the area and spent some time chatting without leaving the area of scent diffusion. Such behavior was absent during the first observation (experiment A). Lonely museum visitors spent more time looking around, taking photos and exploring exhibits in the area. It should be noted, that research team was focused on capturing participants trajectories and taking notes on their behavior and exact time of each participant spent in the area of scent diffusion was not captured and cannot be presented in this study.

Discussion and Conclusion

Current research examined the effect of introduction of olfactory cue in the form of an ambient scent representing rich erogenous and stimulating/bitter dimensions onto the locomotory behavior of museum visitors bridging the existing research gap on potential influence of fragrances on human locomotion. Results achieved during the study generally confirm the substantial body of literature from the marketing and psychological fields that implies that sense of smell can be used as an instrument of sensory marketing and various aromas can be used as a reliable instrument to improve consumer experience and influence consumer behavior.

The choice of the scent representing rich erogenous and stimulating/bitter dimensions was based on multidimensional sensory odor map by Zarzo and Stanton (Zarzo & Stanton, 2009). During pretest the majority of subjects have chosen the complex scent comprised of the pine and cedarwood as the top note, lily of the valley, jasmine and orris as the middle note and musk, amber and woody accord as the base note. This outcome is contrary to results achieved by Hermann et al. (Herrmann et al., 2013) who investigated the difference between simple, complex and no scent conditions. Results presented by Hermann et al. showed that the presence of simple ambient scent had more significant impact on shopping behavior in comparison to similar complex smell or no scent at all. This difference can be attributed to museum being a non-retail environment, nature of scents provided for pre-test and a pre-test procedure, where participants were asked to choose the scent that they thought would be most appropriate for the sex and the sea related theme of the exhibition and would evoke the most emotions in them during the exposure without any related shopping activity. Overall, lack of any related purchase behavior during pre-test in museum environment, limited set of fragrances presented for evaluation and the general setup of the pre-test are factors that can be considered main reasons for the discrepancy.

In line with predictions of the Stimulus-Organism-Response paradigm by (Mehrabian & Russell, 1974) results of the research confirmed the findings of Gulas and Bloch (Gulas & Bloch, 1995) and Douce and Janssens (Douce et al., 2013) that proved that introduction of a pleasant scent can lead to a positive affective and cognitive responses. Results of the current study confirmed the gender difference in scent perception and associated change of locomotory behavior observed by Douce and Janssens. For the sake of clarity, it should be noted, that additional complication that needs to be accounted for and that could have influenced results of the study is the fact that perception of scents is a subjective experience and many physical, psychological and cultural factors have influence on the primary emotional response to olfactory stimuli and resulting behavioral response discussed by multiple authors (Agapakis & Tolaas, 2012; Barwich, 2017; Kastanakis & Voyer, 2014; Secundo et al., 2014).

In relation to saliency of the ambient scent and its related influence current research confirmed observations and related conclusions done by Bosmans (Bosmans, 2006) that when ambient scent is congruent it can impact subject's behavior even when the scent becomes noticeable. Which itself is in part contradictory to later research by Kechagia and Drichoutis (Kechagia & Drichoutis, 2017). The congruency of the scent and associated consequences are a broad topic that requires an additional research and deeper investigation.

Theoretical implications

Observations done during the research confirmed that that pleasant congruent smell can lure people to its source and at the same time revealed the distinctive difference in the behavior of female and male subjects after the introduction of olfactory cue into the experimental environment. After the exposure to the scent 8.75% less women and 10.81% more male participants selected the midway trajectory (pattern 2). It can be speculated that the reason for observed difference is the nature of the topic of the exhibition chosen to be the point of interest for the experimental subjects. It can be argued that the desire and longing of seamen (sex and the sea) which was the main topic of the exhibition triggered different emotions, expectations and mental associations in women and men and thus the effect of the chosen scent was different for different genders, which had its effect on the associated locomotory behavior.

From experimental results it can be concluded that male participants after the exposure to the scent reacted to it and went looking for the source. But when some male subject reached the edge of the bridge (midway point) the intensity of the scent did not change, the source could not be located and it was not possible to see that an alternative pathway leads to the temporary exhibition (it was not visible from the midway point). After realizing all this curiosity subsided and male subjects usually turned back and followed the main path to the exhibition. At the same time, it can be argued that female participants were either more curious when the scent was congruent for them, or did not react to the scent at all (scent was incongruent for them individually and did not trigger mental associations). In cases where scent was individually attractive and congruent for female subjects, they were willing to go further and investigate the source of it more than male participants.

Moreover, the research confirmed the positive effect of introduction of pleasant olfactory cue on the overall behavior and customer satisfaction with the visit to the museum. A noticeable number of experimental subjects slowed down their step or even stopped and spent more time overall in the area where scent was diffused. For example, as mentioned above women spent significantly more time around the area of scent dispersion and enjoyed the atmospherics without any urge to seek the source further. Participants in pairs or small groups in many cases stopped for a while and chatted without leaving the area. Museum visitors that moved alone spent more time taking photos, exploring exhibits in the area or just looking around. Thus, it can be suggested that pleasant congruent smell can be used as one of the aiding factors in retaining the pleasant experience from the visit.

Managerial implications

The body of literature reviewed during the study and experimental data gathered as a result of the field observations suggest that olfactory cues can be used in practical implementations within retail and non-retail environments as a reliable mechanism to improve consumer experience and influence consumer behavior. Data collected during field observations and presented above reinforces the hypothesis, that olfactory cues can be used to influence movement trajectories and overall locomotory behavior.

More specifically it can be suggested that store managers or museum and art-gallery curators can guide people to certain locations with the help of olfactory cues. In addition, the dispersion of pleasant scents can be used to increase the time spent in certain location and to help increase the feel of joy and thus increase the overall satisfaction with the visit. It should be noted, that

choosing the right scent can be tricky and requires attention, time for research and experimentation. Many factors need to be taken into consideration when choosing the proper aroma for the environment. Chosen aroma should trigger pleasant emotions and associations, be culturally acceptable, situationally relevant and attractive. It should not be too weak, so that subjects would not feel it, nor too strong that it would trigger negative reactions.

Limitations and further research

Current research was structured to be as inconspicuous to museum visitors as possible. At the same time to minimize possible ethical issues highlighted by Bradford and Desrochers (Bradford & Desrochers, 2009) instead of covert objective ambient scent, detectable objective ambient scent was used. During the research only the locomotory behavior of museum visitors was recorded, and no interviews were conducted after the exposure to the olfactory cue. In the time of observations, research team was focused on capturing participants trajectories and overall behavior, but exact time of each participant spent within scent diffusion area was not recorded. At the same time, a significantly noticeable number of museum visitors showed the change in behavior after the exposure to the scent and spent more time in the area with the aroma. Therefore, the time spent around the area of scent diffusion should be recorded during future research and associated change in behavior further analyzed.

The procedure of choosing and validating congruent scent was based on the research by Jellinek, Zarzo and Stanton (J. S. Jellinek, 1997; Zarzo & Stanton, 2009). The analysis of data gathered during the research shows difference in behavior of females and males after the exposure to the chosen aroma. It can be argued that this difference indicates that the chosen scent representing rich erogenous and stimulating/bitter dimensions was more attractive to women than men. Further research is required to find situationally congruent scent that would be suitable for both sexes.

Overall, a larger pool of studies is required to allow for more definite conclusions. Additional research should be conducted to investigate the influence of olfactory cues on locomotory behavior of humans in various environments. During future experiments different olfactory cues could be tested out to vary congruency of chosen scents to the environment and situation and measure the impact of more congruent scents versus less congruent ones. In addition, the impact of olfactory cues could be validated against or in combination with other sensory cues, such as visual or auditory cues similarly to the research done by Helmfalk, Hultén, Yang and Chen (Helmfalk & Hultén, 2017; Yang & Chen, 2015).

It should be noted that ethical aspects of the use of fragrances as marketing instrument is not fully officially regulated and is in part a grey area presently. In line with concerns raised by Bradford and Desrochers in their article (Bradford & Desrochers, 2009) more clarity is needed on aspects and associated limitations of using fragrances within both retail and non-retail environments. Additional research and regulatory guidance are strongly required.

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