

Scent, Emotional Memory and Designing for Meaningful Olfactory Experience

Two Exploratory Studies

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Abstract: As the initial part of a design research project on the track of designing for meaningful olfactory experience, this paper reports two exploratory studies. Through two in-depth interviews with scent development and branding experts from *Scent Library Shanghai* and *IFF (New York)*, the first study was intended to clarify the typical scent development processes or methods in the industry and to find out what are the potential challenges and opportunities that designers could exert positive influence and further explore for olfactory design and branding. The second study was conducted as two olfactory association workshops which were aimed to acquire a more comprehensive understanding of how people perceive scents, establish meaningful olfactory associations and express their olfactory experiences; to explore the possibilities of user-centered approaches for designing for meaningful olfactory experience. The results of Study 1 suggest that two aspects in the existing scent development process may need to be improved and further explored by designers: the communication barrier between the users/consumers and scent designers and the harmonious synergy with other designed sensory stimuli. In addition, according to the findings of Study 2, synesthetic visualization is proposed as a promising way to improve current scent development process for designing for meaningful olfactory experience in the future.

Key words: *Meaningful Olfactory Experience, Scent, Emotion, Memory, Exploratory Studies*

1. Introduction

Vision has long been considered to be the dominant sense of human beings and therefore conventional design concept is restricted to vision to a great extent. However, with the increasing number of studies on human multisensory experiences in the design field, other human sensory modalities have attracted great attention recently and designers have started seriously thinking about how to design for a holistic product or brand experience from a multisensory perspective [5,15,16]. Among all the human senses, olfaction or the sense of smell perhaps is the one that is least explored by design researchers, but has great design potentials because of its unique relationship with human memories and emotions.

In his book *Swann's Way*, Marcel Proust [13] describes a vivid retrieval of his childhood memory and a concomitant nostalgic joy elicited by the smell of a madeleine biscuit dipped in linden tea. It has been conceptualized by psychologists as "Proustian Phenomenon" and often used to illustrate how the odor-evoked memories are more emotional than the memories elicited by other sensory stimuli. More specifically, psychology and neuroscience experiments [6,7,11] have confirmed that "the subjective experience of a memory triggered by the olfactory form of a specific cue is more emotional than when memory is elicited by alternate sensory variants

of the same item” [10: 377]. Scientists have provided explanation to such a phenomenon with the help of functional magnetic resonance imaging (fMRI): During the olfactory perception process, two parts of human brain, amygdala and hippocampus, are activated. Interestingly, the amygdala is the emotional center of human brain and hippocampus plays a significant role in memory [9,14].

A meaningful and enjoyable brand scent makes the brand memorable and distinctive among its competitors. With the increasing awareness of the special relationship that olfaction has with memory and emotion, more and more companies have started looking into how to use scents to provide better emotional and memorable user or consumer experience. For example, the famous “new car smell” of Audi is not a coincidence but carefully designed by *Audi Nose Team*. Play-Doh modeling compound has long been using a special product scent to extend its brand identity to the olfactory level. In addition to embedding scents in products, such brands as Starbucks and Abercrombie & Fitch have developed and implemented unique signature fragrances for the retail environments to provide more enriched retailing experience. Furthermore, Singapore Airlines has developed a scent called Stefan Floridian Waters for use at all service touch-points from stewards’ perfume, aircraft interior to the hot towels distributed before meals [12].

Despite the increasing scientific knowledge on olfaction and growing number of successful olfactory design cases, the olfactory experience and how to design for it are still mysterious in many ways. First, the perception of smell is extremely difficult to articulate through verbal language. In *A Natural History of the Senses*, Diane Ackerman [1] notes that it is almost impossible to precisely explain how something smells to another person who has never smelled it. Besides, different people perceive the same odor in different ways. What experience would be evoked by an odor is greatly influenced by socio-cultural factors and personally associated experiences and memories. Also, the sensory modalities are not separate but interactional. For example, looking at the blue color and smell a peppermint scent often leads to a perception of lower temperature and calmness [18]. Perhaps because of these attributes, meaningful olfactory experience is difficult to design for and the designed scent is not always even enjoyable to the users. This interesting quotation from an Amazon customer’s review on the product – “Crayola Silly Scents Crayons” does well illustrate the point: “these crayons do smell - I guess you could say they smell ‘silly’ but I would say they smell ‘stinky’. The crayons have weird smells that remind me of bad perfume.” [4]

The clearly known power and tacit aspects of olfactory experience have made olfaction a new design consideration and research topic which has great opportunities as well as difficulties. As the initial part of a design research project on the track of designing for meaningful olfactory experience, this paper reports two exploratory studies. Through two in-depth interviews with scent development, marketing and branding experts from *Scent Library Shanghai* and *IFF (New York)*, the first study was intended 1) to clarify the typical scent development processes or methods in the industry and 2) to find out if there are any challenges and opportunities that designers could exert positive influence and further explore for olfactory design and branding. The second study was conducted as two olfactory association workshops which were aimed 3) to acquire a more comprehensive understanding of how people perceive scents, establish meaningful olfactory associations and express their olfactory experiences; 4) to explore the possibilities of user-centered approaches for designing for meaningful olfactory experience.

2. Study 1: The Knowledge from the Industry

Though designing for olfactory experience is new to designers, the creation of scent or perfume is a very old activity in almost all cultures. Over the last two centuries, perfume creation and production have become a prosperous modern industry. Meanwhile, the professionals in this industry have developed rather mature methods and processes to develop scents for various clients. When taking olfactory experience into account as part of holistic user experience in the design process, it is reasonable for design researchers to build their research on the knowledge that has already been created in the scent industry and find out the emerging challenges and opportunities that designers and scent professionals (including perfumers, scent researchers and marketers etc.) are facing together. The first study was aimed to do so.

2.1 Method

Expert interviews were used as the method of this study. In order to picture a clearer background, prepare for the interview questions as well as reach appropriate interviewees (i.e. those who had long professional experience as experts in scent research, development and marketing etc.), we firstly collected the information or secondary data about ten most famous scent-related companies or organizations, especially their scent design processes, through the Internet. After that, we contacted several experts working in these companies or organizations through emails and two experts from two different organizations kindly consented to participate in this study.

The first interview was with Banny Li, the managing director of *Scent Library Shanghai*. Scent Library Shanghai is a company that serves both business clients and consumers. As a former official sales and service agency of *Demeter Fragrance Library* in China, Scent Library Shanghai has a strong international background and network but targets at the Chinese market specifically. Thus, Li could provide us with some particular opinions on culture-related scent development and marketing. The other interviewee was Julia Fernandez, the Creative Manager of the *Olfactory Design Studio* at *International Flavors and Fragrances* (IFF). IFF is an internationally leading organization in the research, creation and commercialization of scents, flavors and fragrances. Its predecessor companies have been active in the flavor and fragrance business since 1833. It is now an industry benchmark and represents the most advanced scent technologies, research and development system.



Figure 1: Scent Library Shanghai and Beijing

The interview with Banny Li was conducted at the experience site of Scent Library Shanghai located at Tian Zi Fang on 17 March 2011. At the experience site we could see the scent products in the showroom and smell the scents directly (See Figure 1). After introducing the research aims, the interviewee was asked to introduce himself and the company as warm-up, and followed with questions about their products and services. Because of his rich experience in B2C scent creation projects, the interview questions were more focused on the users'/consumers'

olfactory experience and scent-related everyday anecdotes. Besides, Li was also asked to give opinions on the impact of social-cultural factors on the scent development and marketing. Meanwhile, Li also described the typical process as well as how he thought about the challenges and opportunities of the present scent development. As the further data collection, we visited the flagship store of Scent Library in Beijing two weeks later.

The purposes and process of the second expert interview(s) with IFF was slightly different. It was carried out through emails since the time differences between Helsinki, Shanghai and New York, and also the initial interview request and questions were forwarded to Fernandez through IFF’s corporate communications. The email interviews lasted for over a month in February and March 2012. Fernandez provided a great amount of valuable and practical information about IFF’s scent R&D, including their latest research findings, the state-of-art technologies for creating scent, and approaches for obtain consumer insights and so forth. She also presented their typical scent development process and many good examples. In addition, the social-cultural factors, challenges and opportunities were discussed during the interview(s) as well.

We used affinity diagramming as a collaborative and interactive tool to analyze the data collected from the Internet and expert interviews. As an outcome of the analysis, a visual map was created to clarify the relationships among the different clusters or themes around the existing scent development process. In this map, eight fundamental themes were grouped for understanding the current situation of scent development: 1) Scent Development Process 2) Clients, 3) Scent Technology, 4) Scent Solutions, 5) Social-Cultural Influence, 6) Social and Business Value, 7) User/Consumer Experience, 8) Trends in Scent Design. More importantly, this visual map provided a clearer structure for disclosing the neglected aspects in the existing scent development process.

2.2 Results



Figure 2: The Affinity Diagram

Scent Development Process

Scent development is a process that turns the intangible to tangible, during which scent experts translate the clients’ requests into particular scent solutions and every scent solution usually includes a scent and a delivery system. A typical scent development process begins with the communication with the clients, continues with the insight into the users/consumers and interpreting the trends, ends with the delivery to the marketplace. The social-cultural factors have great impact on the consumers’ preferences for scents, while the scent design trends also evolve with the growing awareness of the value of olfactory experience in the commercial and social areas. Moreover, innovative technologies contribute greatly to the scent research, development and implement.

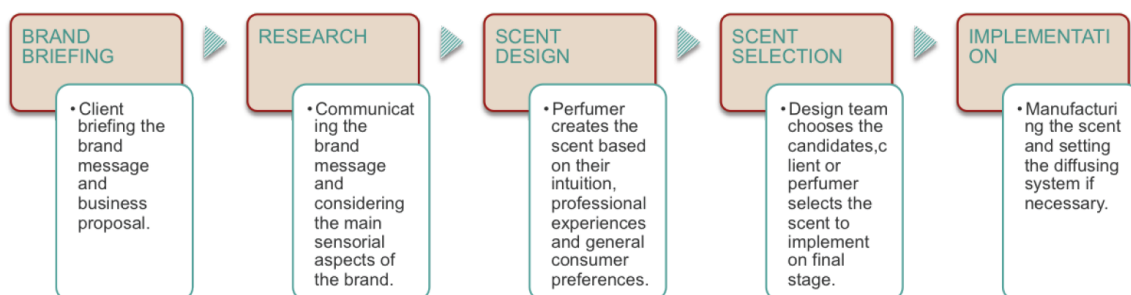


Figure 3: Typical Scent Development Process

The Clients' Awareness and the Most Common Client Request

Conventionally, scent solution providers serve clients mainly from food, detergent, and cosmetics industries. But a growing number of clients from other industries have started paying attention to scent and seeking professional scent solutions for their brands or products, such as Audi from automobile industry, Samsung from consumer electronics, Abercrombie & Fitch from fashion industry etc. Nonetheless, the most common request of the clients retains simply asking for pleasant signature fragrances for their brands. As Li said:

“Clients often ask us to create particular scents for their brands that are able to express the images of their brands ... For example, Audi asked us to create a scent which could convey positive image of the brand to the Chinese consumers; Zhang Yimou, the director of the film ‘Under the Hawthorn Tree’, asked us to design two scents to represent respectively the leading actor and actress.”

Scent Technology and Solutions

Both scent creation and implement rely on rather sophisticated technologies for capturing the scent molecules, diffusing and disposing the scents. After implement, scent experts usually go to the site and exam whether the scent meets to the initial purpose or not, and make adjustment accordingly.

“At Abercrombie & Fitch, we have re-designed the signature fragrance for A&F men to be used in a larger space, and we re-constructed the scent that is automatically spritzed from the lighting tracks by employees.” (Fernandez)

The Socio-cultural Factors

As Fernandez said - “fragrances are an expression of what’s happening in the society” - people from different cultures have different preferences and habits of using scents. Fragrance and its delivery systems evolve with the social and cultural development, from earliest use for religious activities in the East, as medicine in Greek and later Romans discovered the pleasure attribution of scent, and utilized scented dove flying over to shower guest with fragrance. Scent preference in post-war shifted with women’s lifestyle, from conventional to super floral and opulent. While in the past years, nostalgic expression especially to the 50’s has brought Gourmand notes back again to home fragrances. As people’s desire in well-being and natural beauty, raw materials come to the focus. These socio-cultural factors impact on the consumers’ value and preferences, therefore, they should be seriously considered in the scent development process. For instance, western-type scents that have no Chinese cultural roots might not be good options for attracting Chinese consumers in some cases.

“We had a project collaborating with an Italia furniture company, who asked us to create a scent for their trade fair in a shopping mall. We didn’t fully take their advices of using the scent notes of bakery and coffee to

convey a home atmosphere, because their products were targeting the Chinese market and few Chinese people bake or make coffee at home. We finally created a scent with the smells of Linden and Sandalwood for them. It could better present the lifestyle of the target consumer group.” (Li)

User/Consumer Research and Expert-Driven Scent Development

User/consumer research has been recognized as an important aspect by some advanced scent solution providers. For example, the consumer insight and marketing teams of IFF have been systematically studying scent-related trends. Besides, for understanding the influence of scent on individual’s mood and emotional well-being, IFF has developed a self-report method called “Mood Mapping”, which can be used to measure the moods or emotions elicited by different aromas. Comparing to IFF, Scent Library does not have such a systematic plan for consumer research, but their scent designers tend to collect the insights from more casual communications with the local consumers who are visiting their stores. Nevertheless, scent development process still greatly relies on the experts’ intuitions and experiences and is considered to be artistry.

“The selection of the fragrance can be done in a very ‘authorial’ way – the owner, or the designer chooses it, in a very instinctual basis, or test with pre-determined target, that will represent overall likeability of that fragrance for that context.” (Fernandez)

Challenges in the Existing Scent Development Process

One of the most obvious challenges of existing scent development is that the perception of the meaning of a scent cannot be accurately predicted by scent creators during the development process in most cases. Li introduced a project that Scent Library did for a Japanese photographer’s exhibition. They were asked to design a unique scent for each photo series to present a congruent smell conveying the meaning behind the 2D images. One serious problem he realized was that the actual experiences that the visitors had were inevitably influenced by many other factors which were hardly predicted and controlled by the scent designers, such as the individual preferences, associated personal past experiences and olfactory sensibility etc. The scent designers’ intentions are often misinterpreted by the audience.

“...different people perceive the same odor in different ways. Because scent in the environment is not isolated, the perception of an odor is co-functioned by all the senses and also influenced by associated personal memories or experiences, therefore, their reactions are often very different and hard to predict.” (Li)

Furthermore, there is an immanent obstacle to communicating scent through verbal language. For example, consumers often go to Scent Library to ask for a specific scent associated with someplace or someone in their own memories. But the scent designers find it is almost impossible to create the accurate scents that meet the consumers’ expectations because these descriptions are always personal stories which contain only rough information about what specific scent ingredients may be combined to make the solution.

“Odor is mysterious, when certain smell turns out to have an intimate bond with you, it’s not purely a chemical concoction, it’s a carrier of memory. No one can tell what’s in there but the person. And the problem is it’s hard to articulate.” (Li)

Harmonious Synergy across the Five Senses

With regard to the future trends of scent development, marketing and branding, Li and Fernandez both indicated that designing for olfactory experience should not aim to replace the dominant role of visual stimuli in

the marketplace, but rather to use the special effects of scents that other sensory cues barely have to enrich and complete the consumer's sensory experience. Moreover, scent branding should not be limited to only provide each brand a signature fragrance, but to contribute to combining the five senses to provide a synergetic presentation of the brand and as well as the positive and meaningful brand experience in various ways.

"In exploiting the subjective, associative impact of smells in combination with visual images, it's possible to generate a kind of meta-sensory experience that goes beyond purely seeing or smelling ... is not to overwhelm the consumer with the possibility of providing a fragrance trigger on every single brand they see ... by linking an olfactory story to the overall experience, the brand is connecting emotionally with consumers in a more instinctual way ... We are expecting that marketing in the future will involve the usage of color, form and texture combined to develop synergetic presentations, and interact all the systems we have." (Fernandez)

2.3 Discussions

In the first study, we identified two specific aspects in the existing scent development process that may need to be improved and further explored by designers for designing for meaningful olfactory experience: 1) the communication barrier between the users/consumers and scent designers and 2) the harmonious synergy with other designed sensory stimuli.

In general, product experience can be examined from three levels: aesthetic experience, experience of meaning and emotional experience. The aesthetic level refers to how a product may let people have different sensory enjoyments (i.e. visual, audio, tactile, olfactory, and gustatory). The level of meaning is regarding interpretation, memory retrieval and the meanings that people associate with certain products. The emotional level involves what emotions may result from the interactions between a user and a product [3]. In most cases, the existing scent development process only facilitates the olfactory aesthetic experience and emotional experience by providing generally pleasant scents or aromas. But desirable experience of meaning is difficult, if not impossible, to achieve without a comprehensive understanding of the relevant scent memories or culture of the target users. The existing scent development process heavily relies on the tacit expertise of perfumers. It is true that their noses are trained to be more sensitive than those of ordinary people and they have gained years of experience of creating scents. But, their experiences are not always enough for designing the scents that would be perceived to be meaningful or even pleasurable by the users/consumers especially when the scent development is for a product instead of a bottle of perfume. Perfumers who are not familiar with the social and cultural context often are usually not clear about the socio-cultural influences. That means the consumers are very likely not to perceive the designed scent as the way the scent experts expect them to. At the same time, the user/consumer research for scent development is mainly focusing on what scents are generically liked by people rather than discovering the scents which have special meanings to the target groups. Therefore, it is arguable that to increase users/consumers participation in the early stage of the olfactory design process could bring new insights and inspirations for the following design phases.

In addition, scent experts have been increasingly aware of the importance and potential of the harmonious synergy across designed different sensory stimuli. Though this issue has been clearly recognized, the scent development process is still isolated and it has not been embodied in any guidance of how to design the multisensory strategy that could be effectively executed in the multisensory design process. Therefore it is a design opportunity for both designers and scent creators to explore in the future.

The discussions of Study 1 clarify the focus of the next study – to understand the users'/consumers' competence of associating and expressing meaningful memories to odors. More specifically, what kind of olfactory memories and associations do they have both when talk about the scents without presenting them and when they can actually smell the scents? How do they express their olfactory imagery in the former condition and express smell experience in the later condition?

3. Study 2: Understanding the Olfactory Association and Expression

3.1 Method

In order to gain a more comprehensive understanding of how people associate their meaningful memories with scents and how they express scent memories, and also to explore some potential approaches for facilitating users'/consumers' scent expressions which could be integrated in the front-end research of future olfactory design projects, two olfactory association workshops were conducted in Helsinki and Shanghai. Each of the olfactory association workshops consisted of two sessions – a focus group and an olfactory association test. The focus group was meant to lead a group discussion on the participants' everyday olfactory experiences. The following olfactory association test was designated to understand people's associations of scents and expressions without interference from others. Considering the effectiveness, the number of participants in one workshop was limited to four. Therefore, eight people in total participated in this study. The criteria for selecting participants were based on the gender, age and cultural background. Participants included native people from China, Finland, South Korea, and Argentina, with age from twenty to thirty five and an even male-female ratio.

The olfactory association workshops were conducted in an apartment. Each of them took around two hours, including a briefing and warming-up, a half hour focus group discussion and eighty minutes for the olfactory association test, and the feedback session in the end. The whole process was video recorded. In the focus group phase, we, as the moderators, guided the discussions around the participants' olfactory experience, such as how they learnt scents, how scents affect them and how they value different scents etc. Meanwhile, their emotional reactions were also carefully observed. Then in the olfactory association test, each participant was tested individually. Every participant was provided the samples of eight scents that produced by Demeter and freely offered by Scent Library Shanghai. These scents were presented in small reagent bottles containing cotton balls inside. Each cotton ball had been added three drops of one scent and placed for 24 hours prior to the test. Each bottle was labeled with a capital letter (See Figure 4). Four of the scents were extracted from objects in daily life: popcorn, bonfire, apple pie, fire-fly; the other four scents were known as brands' signature scents: Dubble Bubble Gum, Johnson & Johnson baby powder, Play-Doh compound, Chupa-Chups watermelon-lollipop. That was for testing whether the brand signature scents would arouse participants' memories of the corresponding brands. Participants were asked to smell the eight scents one by one in a random order and then describe what they had in their minds while or right after sniffing the scents. They were allowed to sniff one scent as long as they needed, but only single scent at a time in order to minimize the blend of different scents. They were also instructed to smell coffee beans to refresh their nasal passage between the tests of two different scents.

The test was meant to explore the participants' olfactory associations and expressions rather than test their abilities to recognize or identify the scents. So the participants were encouraged to describe whatever came to their minds and as detailed as possible. They were asked to tell what products and events they recalled, who were in

those memories, where those episodes happened, what moods or emotions they had at those moments, whether they were related to any particular brand etc. The key descriptions or associations for each scent was written down on post-it and stuck aside the scent bottle. After each participant described one scent, we presented the name of the scent (e.g. Label A: Bubble Gum) and some pictures related to the scent. Then, the participants were asked to continue complement the descriptions with the assistance of the visual cues. Sniffing the scents was allowed if needed. This was for testing whether the scent name label and visual cues would facilitate the expressions and evoke stronger emotions.

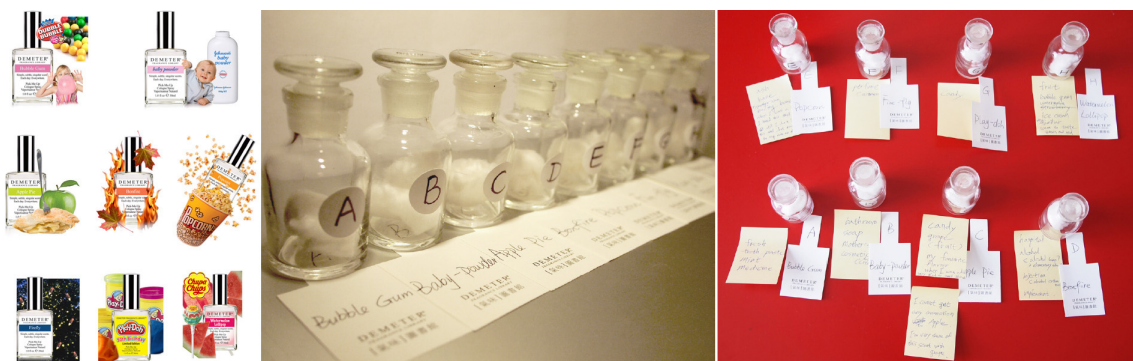


Figure 4: Sample scents for the olfactory association tests

3.2 Results

In the study 2, many results were found as expected. First of all, the Prounstian phenomenon is common. Every participant in the focus group discussions admitted that he/she had experiences of the memory flash back evoked by certain scents and claimed that such experience usually brings strong emotions, mostly positive, although it only stayed for a split second in most cases. Secondly, when the participants were exposed to a familiar scent, they could quickly realize that they knew the scent at some past time in somewhere. But they did not pay any attention or show particular emotion to a scent that they had no memories about. Thirdly, cultural background, growing-up environment and lifestyle habits greatly influence people’s perceptions and preferences for scents. For instance, the participants who were originally from harbor cities showed a special fondness for the fishy smell while those who were from inland China felt that smell unpleasant somehow. Another example from the olfactory association tests is that the participants from Asia were very familiar and excited about the scent of Watermelon Lollipop, but the ones from Finland associated nothing special with this smell. One of the reasons for this difference might be that this flavored lollipops and ice lollies used to be very popular in many East Asian countries two decades ago, but it had never been a popular flavor in Finland as the participants themselves explained. In addition to these anticipated findings, there are some other interesting ones with respect to people’s competence of olfactory association and expression that may inspire designers. They are discussed in the following section.

3.3 Discussions

First-time Experiences

Meaningful memories associated with scents are often about one’s first-time experiences, especially during the childhood and major transitional periods of life. In the focus group discussions, most participants talked about the olfactory experiences that happened in their childhoods when they were asked to describe some most meaningful and impressive odors. For example, one participant said “every time by smelling a fig I remember the

kindergarten, where a fig tree was there. I remember taking the figs and putting them into my pocket.” Similar results were also observed in the olfactory association tests. When the participants smelled the bubble gum scent, most of them recalled childhood and one participant associated it with “a picture of the classroom in primary school”. This result can be explained by the findings of relevant previous psychology studies that people acquire the emotional meanings of scents during their young ages. This is why childhood, a time replete with first-time experiences, is a pivotal training ground for scent learning [8].

In addition to childhood, people also tend to memorize new scents in the major transitional periods of their lives, which are also full of the first-time experiences. For example, a Chinese participant expressed that the sauna smell is one of the most memorable smells for her since she moved to Helsinki five years ago. Another participant mentioned that the smell of his professors’ painting studio left him a strong impression. It happened when he just started his undergraduate studies, the first time of leaving his hometown. Furthermore, A Finnish participant recalled the memory of his early army life when he smelled the scent of bonfire. Many participants in the focus group also mentioned they had strong impressions of the smells of different airports. If we regard the airports as the places where the new experiences start, then it might be also the places where the scent learning system is activated.

Loved Ones and Intimate Experiences

Meaningful scent memories and associations are often formed through intimate relationships. The odors of loved ones (e.g. parents, grandparents and lovers) were frequently mentioned as pleasant and meaningful odors by the participants.

“My grandma has a special smell. I don’t know how to describe that kind of ‘old lady smell’. It brings warmth and peace. The smell maybe is a mix of the smell from books and sandalwood because she likes being in the study and reading every day. ”

“I think the smell that impressed me more was the perfume that worn by the guy who I fell in love with for the first time. When I smell it again, I remember the feeling of being in love.”

Everyday life and Repetitive Experiences

The repetition of smelling the same scent in everyday life forms a strong association. For example, in the focus groups, most participants mentioned the scent-associated memories were related to what they used to do frequently. These scents are overlooked in most time, but can be very powerful when they appear and evoke those nostalgic memories. For instance, when smell the Play-Doh scent, one participant said “it smells so familiar for me”, and she associated a cabinet full of toys. When she was told it is the smell of Play-Doh, she excitedly talked about her childhood life and said, “I spent a lot of time during my childhood in that cabinet. If my friends came to visit me at home, they always knew where to find me. And yes, I’m sure I had a set of Play-Doh in that cabinet, the smell in the air might be mixed with plastic or wood scents from other toys. I was immersed in that smell every day. ” Another participant mentioned, “I always have flashback when I smell toluene. We used to glue plastic to make mock ups at the design school in Buenos Aires. We knew it was quite toxic but it was the only way. It reminds me of the long days and night working on the mock ups.”

The Signature Scents of Brands

One of the purposes of the olfactory association tests was to see whether the single presence of the signature scent of a brand would make the people recall the brand information. The results did not show supportive evidences. None of the four brands' signature scents could evoke such brand information retrieval, but rather autobiographical memories of the general contexts of using the products.

Multisensory Association and Synesthetic Expression

It was interesting to see the participants tended to describe the perceived scents through the words that are normally used to describe visual, taste or tactile experiences. They described the scents in colors and shapes: bubble gum smells “colorful”, watermelon lollipop smells “red and green” and “triangle shaped”, firefly smells like “green apple”. The attributes in gustatory and tactile senses are also mentioned: lollipop is “fruity”, “run in my mouth”, and popcorn smells “sweet” and “soft”. The synesthetic expressions not only appeared when the participants were responding to the presented scents, but also existed when they expressed their memories of the scents. For example, one participant said, “summer and winter have different smells. Summer smells fresh especially after the rain, while winter smells cold.” Another participant said the Play-Doh scent “makes me want to wash my hands”. Synaesthesia is a very natural capability among people. It might be attributed to the fact that memories of scents are connected with the previous multisensory experiences - what they saw, heard, smelled, touched and tasted. In addition, many participants expressed that they had synesthetic associations and form visual scene before identifying the presented scents. For instance, when sniffing the smell of bubble gum, one participant's first impression was that: “It reminds me of a picture of colorful aromatic beads I used to contain in my pencil box when I was in primary school...”

4. General Discussion and Design Implication

The findings of Study 1 uncovered two specific aspects in the existing scent development process that may need to be improved and further explored by designers: 1) the communication barrier between the users/consumers and scent designers and 2) the harmonious synergy with other designed sensory stimuli. The findings of study 2 could help to identify some possible ways to improve the process for designing for meaningful olfactory experience.

4.1 Improving the Scent Design Process by Synesthetic Visualization

Well-documented evidences suggest that the verbal language and olfaction are poorly interconnected [17]. In the current study, likewise, participants in the workshops frequently reported the difficulties in expressing the scent perceptions through verbal descriptions. It reveals the gap between olfaction and language, which eventually leads to the barrier of communication. The olfactory association workshops demonstrated the synaesthesia exists when people expressing the scent experience. Since synaesthesia enables people to have the visual images of scents and better express their olfactory experiences, it may be promising to use synaesthesia visualization as a medium to assist peoples' olfactory expressions and ultimately bridge the olfaction-language gap. For example, apart from olfactory stimuli, designers could consider using photo collages or other visual expressions to encourage users to describe their olfactory experiences. Moreover, as we can see from the workshops, the simultaneous presence of the olfactory and visual stimuli of one scent activated the storytelling which helped the participants better express their meaningful olfactory memories. It provides a fundament for optimizing the user/consumer research phase at the onset of olfactory design process.

An issue worth noting is that visual stimuli may also have negative effects if not use them properly. For example, in one psychological study [2], participants were asked to identify scents either with the scents alone, with colored chips, or with colors' names (e.g. red). One of the findings shows that visual stimuli (colors in this case) facilitate recognizing scents if it is relevant, whereas irrelevant colors increase incorrect identifications.

4.2 Product Scents, Ambient Scents and Olfactory Touch-points

From a service design or holistic brand experience perspective, there is a distinction between product scent and ambient scent. Product scents and ambient scents have different impacts on the formation of users/consumers memories. Product scents usually play an important role during the use. For example, the special scent of Play-Doh enhances users' olfactory experience in the whole playing process and such olfactory experience repeats with the long term use and then it becomes meaningful in their memories. However it is not presented in the shopping stage. On the other hand, some brands like Abercrombie & Fitch use the signature scents as ambient scents, which can only be perceived during the shopping stage and the olfactory touch-points in usage are missing in these cases. Although ambient signature scent is not involved in this study, the important function of it should be kept in consideration. Designing for meaningful olfactory experience for promotion, shopping and use may need different approaches which are worth exploring in the future.

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