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Olfactory Vision: Recollection of Visual Information Through Smell in Graphic Design

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OLFACTORY VISION: RECOLLECTION OF VISUAL INFORMATION THROUGH SMELL IN GRAPHIC DESIGN

by

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Under the Direction of Xinran Hu, MFA

ABSTRACT

Olfactory Vision is a social study conducted to understand the influence of a scent within graphic design processes, enhancing the recollection of details. Twenty-four random adults were tested. The experiment was divided into three groups, A, B, and C, presenting two sets of cards; the first had symbols, and the second one had typefaces. A summary of the investigation was provided; however, the rose oil fragrance was not revealed, avoiding conditioning the subjects. The participants had an in-person and follow-up questionnaire one week after, testing their short and long-term memory. The results generally showed no significant difference between genders. In general, the scented symbols had a total recollection of 67%, while the typefaces only had a

28%. This study seeks to provide important data that may influence the field of Graphic Design by integrating other senses beyond traditional visual imagery.

INDEX WORDS: Olfactory, Smell, Fragrance, Smell design, Recollection, Recognition, Memory.

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MONICA SUAREZ ARGUDIN

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Office of Academic Assistance

College of the Arts

Georgia State University

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DEDICATION

Para mi Nanay, de quien aprendí sobre el olor de las rosas.

ACKNOWLEDGEMENTS

I want to thank my thesis committee members, Xinran Hu, Catherine Wright Trugman, and Kate Cunningham, for encouraging me throughout this process. Also, to Nedda H. Ahmed for her guidance and deep feedback; without her help, the writing of this paper could not have been possible. To Jamie Zarah Zaikov for assisting me through the exhausting IRB approval process. Furthermore, my family and close friends for listening to my long talks about the project and motivated me during its creation. Finally, a special thanks to Pedro Montiel, who has not only been a great support during my entire degree journey but also has believed in me more than myself; words cannot describe how much his help and presence have meant to me.

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1 INTRODUCTION

As communicators, graphic designers always look for exciting ideas to connect with our audiences visually. In an era of many distractions, we find it increasingly hard to catch people's attention and then for the viewer to retain the information conveyed in the printed materials we design. Digital platforms have conquered the world's eyes, relegating hard copies to a second plane in several scenarios. I found it very interesting that a powerful sense like smell has little to no relevance in today's graphic design solutions. Psychological investigations indicate that our memory of smell is far more effective than our visual recollection. As discussed on the Unexplainable podcast series: Making Sense, "All knowledge must come through the senses." What would happen if we combined both senses to carry a message to a targeted audience? This thesis project will review how human subjects respond to visual information while exposed to smell; and whether a scent added to a graphic design solution can improve communication or influence viewers' recollection of specific details.

To begin untying a very intricate topic, we should understand first, how the sense of smell works and how odors have played an essential role throughout history. Until recent years, humans were thought to sense approximately 10,000 odors. However, our powerful sense of smell can detect about a trillion odors and decode them to help us make sense of the world around us (Decker, 2019, para. 2). Some smells are more complex than others: the smell of chocolate, for example, contains more than 600 chemical scent components. According to Christopher Bates and the *Wekiva Culinary Newsletter*, only 25% of what one perceives as taste comes from our taste buds. The molecules of an odor interact with the olfactory receptors inside the nasal cavity during inhalation. These receptors transmit a message to the olfactory bulb, which processes the information and sends a specific signal to the olfactory cortex in the brain's

temporal lobe. The primary olfactory cortex includes the amygdala, which computes emotional experience and memory, and the hippocampus, which is involved in associative learning (Herz, 2016, para. 5). In contrast, signals delivering visual, auditory, and tactile information do not reach these areas in the higher cortex. Moreover, unlike our other senses, our noses directly link the environment and our central nervous system (Decker, 2019, para. 4).

The term perfume comes from the Latin "per fumum," meaning “through smoke.” Perfume was invented around 4000 years ago among the Mesopotamians in the form of incense (Herz, 2011, para. 8). Since antiquity, perfume oils and incense have been used for ceremonial purposes in rituals for the dead, for pleasure, and for medicinal purposes (Brun, 2000, p. 296). The ancient Egyptians took great pride in their cleanliness; they used aromatic oils and creams for protection against the hot sun and the dry winds. Their priests believed that certain types of perfumes could even add to one's power. The most used ingredients for creating their fragrances were: myrrh, thyme, marjoram, chamomile, lavender, lily, peppermint, rosemary, cedar, rose, aloe, olive oil, sesame oil, and almond oil (Chaudhri, 2009, p. 164). In Egypt, the art of essential oils held such cultural significance that we could even find paintings, such as the one in Rekhmire's tomb (around 1420 B.C.), representing perfumers at work. The Hebrews also were great users and producers of olive oil-based perfumes. Scientists have discovered archeological evidence of perfume production in Palestine. The most substantial evidence for the perfumery industry, however, comes from The Roman period (Brun, 2000, p. 280).

Because the primary goal of this thesis is to understand how smell could influence our recollection of information, it is also vital to comprehend how odors and memory connect. It is known that odors linked to good memories can make us happier and enhance our health in many ways (Decker, 2019). As Herz (2016) discusses in her article in *Brain Sciences*, “Since odors

elicit more emotional memories than other stimuli, and because odor-evoked memories tend to be positive, odors may be especially helpful for enhancing mood states" (para. 2). Odor memory comprises two distinct cognitive-perceptual processes. One is known as smell recognition and identification, which is the ability to distinguish and store smell data. The other one, when an odor triggers the recollection of past events, is identified as odor-evoked memory (Herz, 2016, para. 3).

Some key elements help us separate odor-evoked memories from recollections evoked by auditive or visual stimuli. They are rarer and happen less frequently, yet they are remarkably visceral. Existing studies show that autobiographical memories triggered by odors feel much more emotional, activating the neurological substrates of emotional processing and associative learning. People who experience odor-evoked memories are more likely to recall the original time and place of the episode than when the same events are evoked through other modalities. Some studies have proven that events recollection through smell therapies could vary with age and gender (Willander, 2006, p. 240). Willander and Larsson (2006) in their article on smell, conclude, "taken together, the available evidence suggests that odor-evoked memories may differ both with regard to age distribution and in phenomenological quality from memories associated with other sensory modalities" (p. 240).

The mere act of smelling activates the amygdala-hippocampal complex. However, the process of recollecting an odor-evoked memory particularly increases activity on the amygdala. Unlike other sensory systems, olfactory information is indirectly processed through the mediodorsal nucleus of the thalamus, which appears to play a role in modulating attention to odors. The primary processing of odors occurs in the amygdala-hippocampal complex of the limbic system. None of our other senses have this level of targeted connection with the areas of

the brain that process emotion, associative learning, and memory. Pleasant memories can prompt positive mood and invoking such memories as a therapeutic technique helps relieve emotional distress in diverse clinical conditions, as positive moods and emotions are known to be beneficial for psychological health (Herz, 2016, para. 8).

2 LITERATURE REVIEW

This research journey began by finding and reviewing books, journals, and websites that showcased the use of smell in design and visual works. However, in shaping this study's methodology, my instinct took me beyond graphic and two-dimensional disciplines. I was eager to learn about other researchers and designers that applied odor in their creative processes, from industrial design to filming and architecture. I also examined previous methods exploring the relationship between smell and learning. The smell-based experiment I started developing also resonates with scientific and psychological literature, proving that smell can trigger emotion-based memories and help with information recall and learning.

2.1 Case Studies

The idea of merging smell and cinema in one single experience goes back to the beginning of silent film. Establishing an accurate date is difficult since several sources differed on when it happened. However, it seems to be a consensus about the Family Theater in Forest City, Pennsylvania, where an audience of a Rose Bowl game was sprinkled with rose oil in 1916 (Brownlee, 2006, p. 3). It is also recorded that Samuel "Roxy" Rothafel, a cinema mogul that ran important New York Venues like the Rialto and the Strand, was among the pioneers of the stunt. Rothafel proposed dipping cotton wool in rose oil and using an electric fan to blow the aroma into the viewers (Gilbert, 2008, p. 148). Smell-O-Vision, the first case study included as a

benchmark to develop this study's experiment, was a technology by Hans Laube that attempted to include odor in cinema.

As Avery Gilbert discusses, Laube's first scented film was displayed in 1940. A theatrical scent system released multiple scents like rose, hospital atmosphere, car exhaust, among others, synchronized with the film's scenes. Coincidently, a new cinematographic trend, sound, emerged, causing the scent technology to fade away (Brownlee, 2006, p. 3). Smell-O-Vision was not dead, in any case. In 1960, Elizabeth Taylor starred in Mike Todd Jr's film adaptation of Cardiff's thriller *Scent of Mystery*. The American producer applied what he called "Glorious-Smell-O-Vision." Using scents on each theater seat, the organizers offered clues to the murderer's identity. It was an expensive undertaking in which the seats were connected to a system of tubes linked to a central scent device. The experience was only available to audiences in only a few cinemas in Los Angeles, Chicago, and New York (Spence, 2020, para. 19). The ads shown during the film read: "First they moved (1895)! Then they talked (1927)! Now they smell (1960)!" (Brownlee, 2006, para. 6). To disperse the right scent at the right time in the auditorium, a signal on the film's soundtrack triggered the release of a typical neutralizing odor prior to the release of the following smells in the sequence (Spence, 2020, para. 19).

Figure 2.1 Photo Art Shay

In 1965, the technology had another brief resurgence in the television industry. During an interview on the BBC, a professor claimed to have designed a device he called "smellovision." This device would allow viewers at home to smell scents produced in the television studios. While demonstrating his technology, he sliced onions and brewed coffee. The professor invited viewers at home to corroborate the aromas emanating from their cathode ray tubes; several viewers affirmed that they smelled Smell-O-Vision in their homes. Sadly, the professor and his device were all part of an April Fool's hoax, and the Smell-O-Vision technology was again delayed. In 1992 MTV re-aired *Scent of Mystery*.

Science intends to go much further today, developing several projects like the iSmell Personal Scent Synthesizer by Digiscents, Inc., a device that would allow smells to be transmitted through the Internet (Brownlee, 2006, para. 12). However, the story of Smell-O-Vision shows that scent technologies have not got as far as their potential mainly because issues

with smell diffusion, image synchronization, and costs, but the promise is still there (Olofsson, 2017, p. 455). It was fascinating to go back in time and realize that rose oil was among the first scents used to complement a visual message as I discovered other facets of this scent further along my research. This case study informed my design process on keeping strategies and materials for scent diffusion as simple as possible, avoiding other variables from competing with the smell-image connection.

To examine how architecture and urban design have incorporated the olfactory sense in their approaches, this review explored as its second case study the work of Dr. Kate McLean's "Sensory Maps." In this work, Dr. McLean generates Smell Maps using data from various cities that visualizes the distinctive smells of different neighborhoods. She generates this data by conducting "smell walks" throughout the cities she maps, asking participants to record odors and their locations. According to her, recording odors through time can provide important insights into social and cultural change (Traverso, 2017, para. 3).

In the publication *Smelly Maps: The Digital Life of Urban Smellscapes*, Dr. McLean, together with other authors, explores the possibility of using social media data to map the smells of entire cities reliably. To create these maps, they collected geotagged images from Flickr and Instagram and georeferenced tweets from Twitter. After gathering the data, they matched the tags and tweets with the words in the smell dictionary. They found that smell-related words were best classified into ten categories (Metro, Nature, Animals, Waste, Synthetic, cleaning, Tobacco, Food, Industry, and Emissions); one of their main contributions while conducting the research was the creation of the first urban smell dictionary. They also found that specific categories, such as industry, transport, and cleaning, corresponded to governmental air quality indicators, adding validity to their study (Quercia et al, 2015, p. 328).

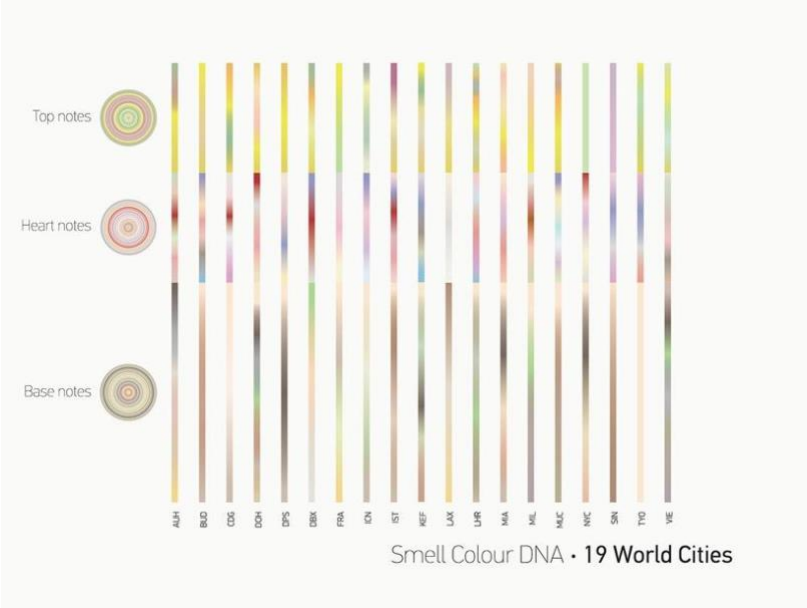

Figure 2.2 Dr. Kate McLean. 2011

Dr. McLean uses different approaches in her research and has worked on other smell-related projects. She recorded the odor of streets, hospital waiting rooms, the odors of the morning and the evening of specific towns, and boring talks. She even created a visual representation of smell in her Smell Colour DNA, a project reviewed during the research conducted for this thesis since it involved creating a visual language for scent. McLean's visualization process was partly inspired by her previous experiments in which odor was visualized in watercolors. She used scent note data from an urban perfume set called "The Scent of Departure" by Gerald Ghislain and designer Magali Sénéquier to create images for the city's scents. Development work by Dr. McLean included calculating the color of each scent used in perfumes and developing an opacity for each color based on its frequency of occurrence in the range of aromas: the more frequently a fragrance was used, the higher its opacity (McLean, 2011, para. 2).

The interconnections between smell and color in the above case study brought our research to Synesthesia, a condition in which a person experiences a blending of the senses. In people with Synesthesia, stimulation of one modality simultaneously produces sensation in a different one. Synesthesia is also considered a conscious experience of systematically induced sensory attributes not experienced by most people under comparable conditions (Cytowic, 2018, p. 10). Those who experience Synesthesia, known as synesthetes, can hear colors, feel sounds, and taste shapes. As children, synesthetes quickly discover they perceive the world differently. There are many possible sensory permutations, and the range of synesthetic performance in clinical experience is broad. One patient may present a highly restricted form of colored hearing, in which only a particular voice or specific kind of music will elicit image perceptions or photisms. On the opposite side of the spectrum, stimulation of one sense can cause the pentamodal patient to experience Synesthesia in the remaining four (Cytowic, 2018, p. 10).

There are several forms of Synesthesia, like Day-Color, Vision-Touch, Music-Color, and Taste- Shape, among others. As Grossenbacher and Lovelace discussed, the term "inducer" describes the stimulus that triggers the Synesthesia, and the term "concurrent" suggests the experience itself (Grossenbacher, 2001, p. 36). Every type of Synesthesia can be minimally described as an inducer-concurrent pairing. For instance, music-taste and grapheme-color denote types of Synesthesia in which music elicits taste, and graphemes (units of written language) elicit colors (Ward, 2012, p. 50). After many years of studying Synesthesia, there is still no precise definition for it. Nonetheless, scientists seem to concur that synesthetes have very little control over the onset or content of their experiences. In this regard, we can affirm that Synesthesia is more akin to perception than mental imagery (Ward, 2012, p. 50). These findings provided helpful information that might support our project's goal of using smell as a design tool, like

color or shape. It also sets the grounds for testing their combination as a vehicle to improve perception and data recollection.

Figure 2.3 Amplifier. Omer Polak

It was essential to include some research that had a similar approach to the intended study of this thesis to develop the ideal methodology. The S-SENSE project was evaluated since it also combines design and neuroscience. The artist Omer Polak develops this project in collaboration with the Weizmann Institute of Science. In this work, Polak introduces research on the sense of smell and its uses. He started the project as personal research. Polak first tried to experience the world through smells and without them, learning from his own odor using a specially-design mask. The S-Sense project consists of three objects: an odor-learning device and two artificial smell-distribution tools. The project's primary goal was to develop a device that could help anosmic people (individuals with reduced smell receptors) to improve their sense of smell. The idea was for them to learn different types of odors by practicing and understanding them using biofeedback (Polak O., 2014, para. 3)

Figure 2.4 Smell Yourself. Omer Polak

The designed device diffuses pleasant and unpleasant odors accompanied by images and sounds produced by a computer. Next, the user was asked how they perceived the smells and whether they were pleasant. During the procedure and in an unanticipated way, the device diffused odors without sound and image, and the user was asked whether he noticed the smell or not. The device design was based on the belief that we often experience the world via the senses of sight and hearing. By adding a compatible odor, the individual could comprehend that a particular feeling is positive and the other is not. Thus, even if the user does not perceive a bad smell, the matching process will allow him to know whether the odor is pleasant or unpleasant (Polak O., 2014, para. 3)

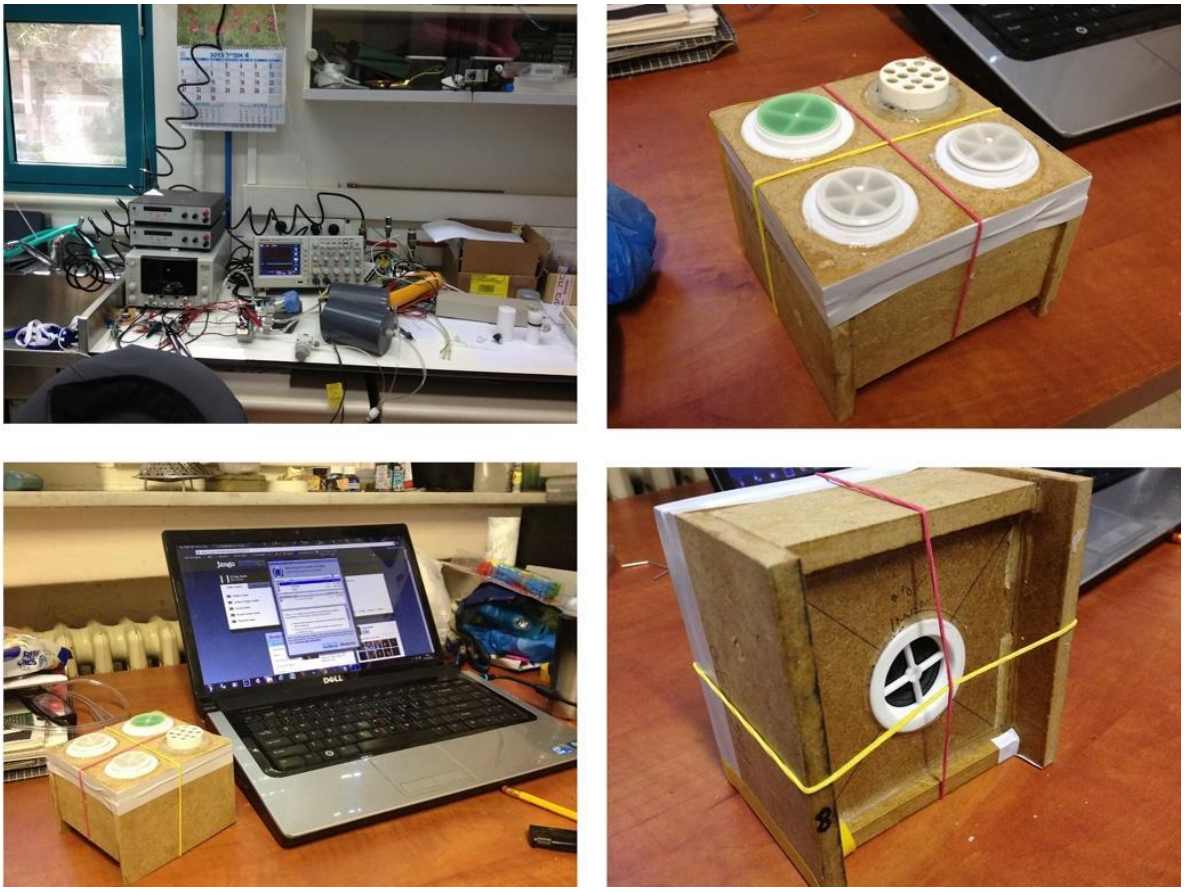

Figure 2.5 Prototype. Omer Polak

2.2 Scent and Memory in Learning Environments

Since the central intention of this research is to understand how the use of smell in graphic design processes can influence the viewer's retention of information, it was essential to evaluate existing research on the impact of smell in learning environments. A recent study by Dr. Jürgen Kornmeier published in *Scientific Reports* confirms that using aromas during learning and sleep might improve test performance. Some earlier studies indicated that researchers must present the odor during slow-wave sleep to succeed. They had to track the subjects' sleep using high-tech equipment to accomplish this. The new study set out to understand whether the old technique could be successful outside of the lab since even when effective, it was useless for the

general public (Neumann Franziska, 2020, para. 12)**.** The study tested the effect of rose scent on the memory performance of eleven and twelve-year-old German students. The students were placed in different learning contexts and observed while sleeping at home and while engaged in memory retrieval tests (Neumann Franziska, 2020, para. 20).

2.3 Olfactory Fatigue

This research also reviewed existing studies on the different ways of fighting olfactory fatigue to include it in the study's methodology. The first item reviewed was a statement from Nick Rabuchin, Vancouver Candle Company's founder and creative director. He explains that olfactory fatigue is when the olfactory glands in the nose work harder to recognize scents; this phenomenon is also known as "nose blindness." Rabuchin stated that an olfactory fatigue reset is necessary for these situations and that "Perfumers will sniff the crook of their elbow to reset the system." He goes on to say, "You are always performing olfactory habituation to your own smell, so it is a perfect baseline" (Faller, 2021, para. 5).

Another interesting finding was a scientific study on the use of coffee beans for refreshing what is also known as the olfactory palate. This technique is well-known in the perfumery industry; however, according to the research, smelling coffee beans did not result in higher mean accuracy of identification of novel fragrances. The study also showed that coffee beans and lemon have no unique, refreshing properties. According to their results, fragrance sellers should reconsider providing coffee beans to their customers. (Grosofsky, 2011, p. 538).

2.4 Summary

Useful findings during the bibliography review were used to elaborate the study methodology, such as rose oil's aroma applied to test the study. The presented research about scent and memory in learning environments supported the intended fragrance. I also learned and

gathered essential efforts to fight olfactory fatigue; these findings were included to design the most accurate process to avoid altering the data results. The case study of Smell-O-Vision provided general ideas about the evolution of scent within storytelling settings; some of these techniques were explored while developing the study's strategy as ways of incorporating smell into printed materials.

The reviewed project on smelly maps, The Digital Life of Urban Smellscapes of Dr. McLean, was also an interesting case study; it provided ideas on developing a visual language for scent color and guided us to learn about the Synesthesia condition. These findings were used only as an inspiration for representing the research during the exhibition, but there were not added to the actual study methodology. Some of the methods from the S-SENSE project were also evaluated to understand existing technologies available for demonstrating this thesis argument. Using an EEG device was one of the leading suggestions we gathered from this experiment; however, the use of said device in this thesis study was denied by the Institutional Review Board (IRB).

3 METHODOLOGY

This study was approved by the Institutional Review Board (IRB); the consent was received on February 15, 2023. Participants from the general population unrelated to the arts and design fields were invited to participate in the study; twenty-four random adults volunteered. The ages ranged from 18 to 28 years; 58.3% were female, and 41.7% were male. The recruitment strategy was to extend personal invites and distribute flyers around the university. The ad material showed the brand identity developed for the project. A guideline was essential for the visual components to keep the study and exhibition elements unified (Figure 3.1). A general

summary of the investigation was provided. However, the presence of fragrance was not revealed, nor was the specific answer this test attempted to comprehend, avoiding, this way, conditioning the subjects to the variable. The experiment was conducted in a quiet and private room at the university's library.

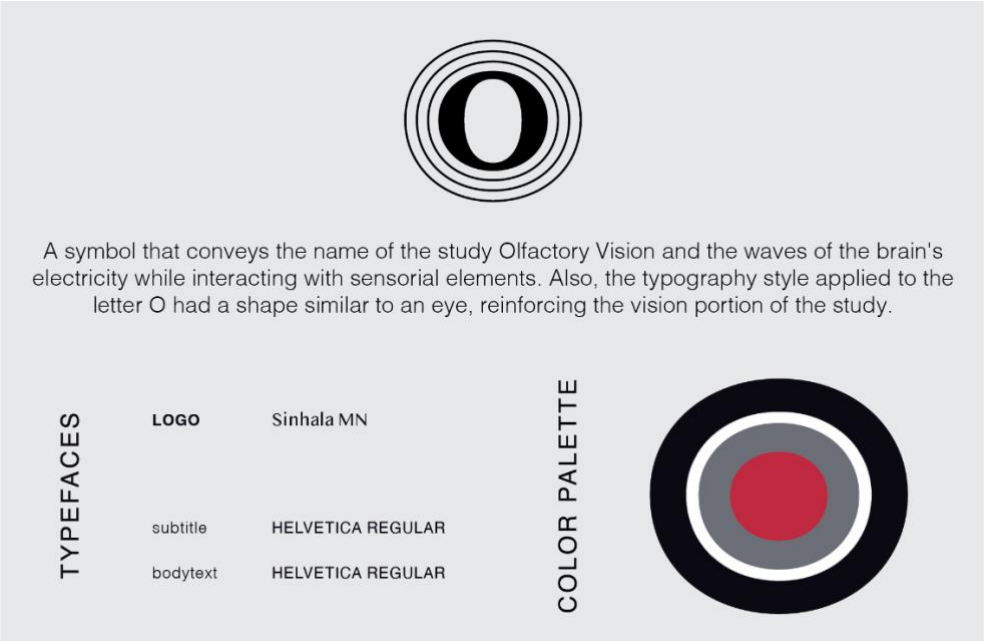

Figure 3.1 Brand Identity. Monica Suarez Argudin. 2023

3.1 Procedure

The experiment was conducted over two days, around the same time, from 10:00 AM to 1:00 PM. The time used to perform the experiment on everyone was about ten minutes. The individuals were welcomed and invited to sit in front of a digital screen, where a visual presentation was displayed for guidance during the process (Figure 3.2). The first step was to read and sign the informed consent form, then provide demographic details and contact information for a follow-up questionnaire a week after the in-person study (Figure 3.3). During step three, the moderator, in this case, myself, explained to the participants that the cards would

be placed on the table next to the screen, facing down. They should pick it up, flip it over, and hold it for about 5 seconds as close as possible to their face and then about 25 seconds from a comfortable distance, analyzing its visual info. This procedure was repeated six times in total.

Figure 3.2 Experiment Instructions. Monica Suarez Argudin. 2023

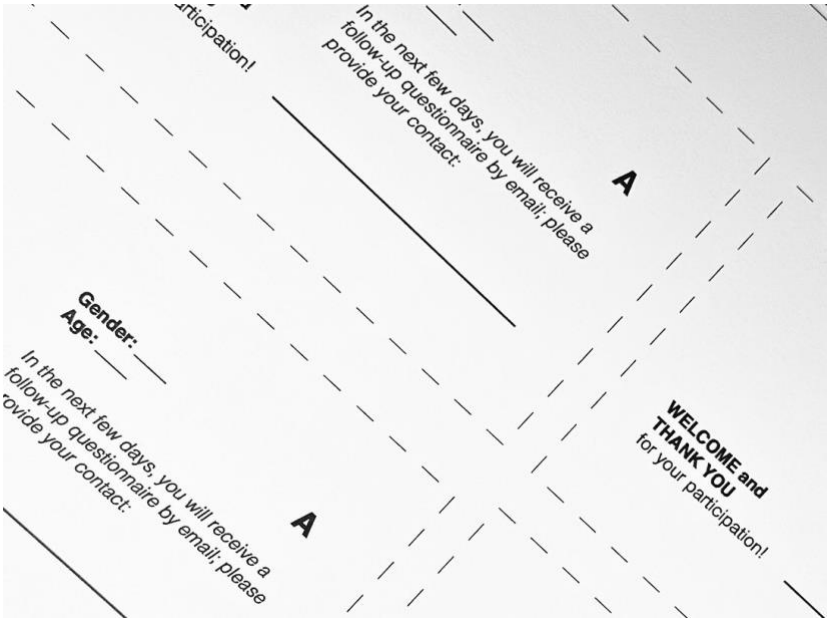

Figure 3.3 Demographic Information. Monica Suarez Argudin. 2023

The study presented two sets of cards; the first set had symbols, each with a different design but a similar shape, and the second set had typefaces (Figure 3.4). The typefaces shown were serif, but all were designed differently; they offered the same word, "olas," which means waves in Spanish. The last card of each group had a rose scent on it. The moderator kept the cards behind the screen; thus, the tested person could not see where the cards were coming from. All the scented cards were stored in a different box inside a plastic envelope to prevent contaminating the cards without the smell (Figure 3.5).

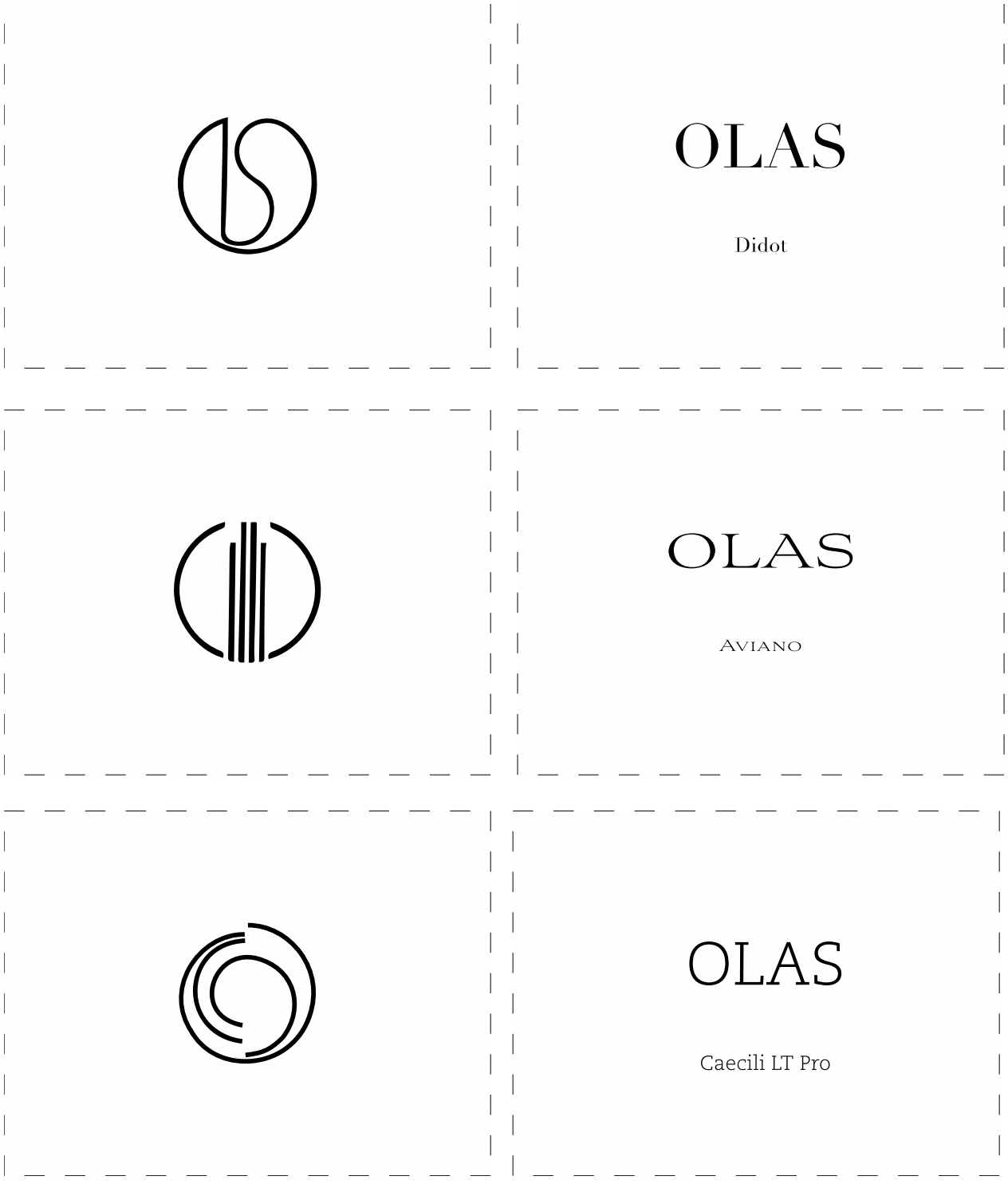

Figure 3.4 Set of Cards. Monica Suarez Argudin. 2023

Figure 3.5 Experiment Boxes. Monica Suarez Argudin. 2023

After the participant interacted with each card, the moderator collected it and placed it on a disposable envelope, one for the ones with the aroma and another for the ones without; these envelopes were also hidden from the participants. Every subject had their own set of cards to prevent, in these times of COVID-19, the spread of the virus. As a last requirement, the subjects filled out two answer keys, responding to the question: Which of the following was the most memorable? First, they completed the symbols answer key and then filled in the one for the typefaces (Figure 3.6).

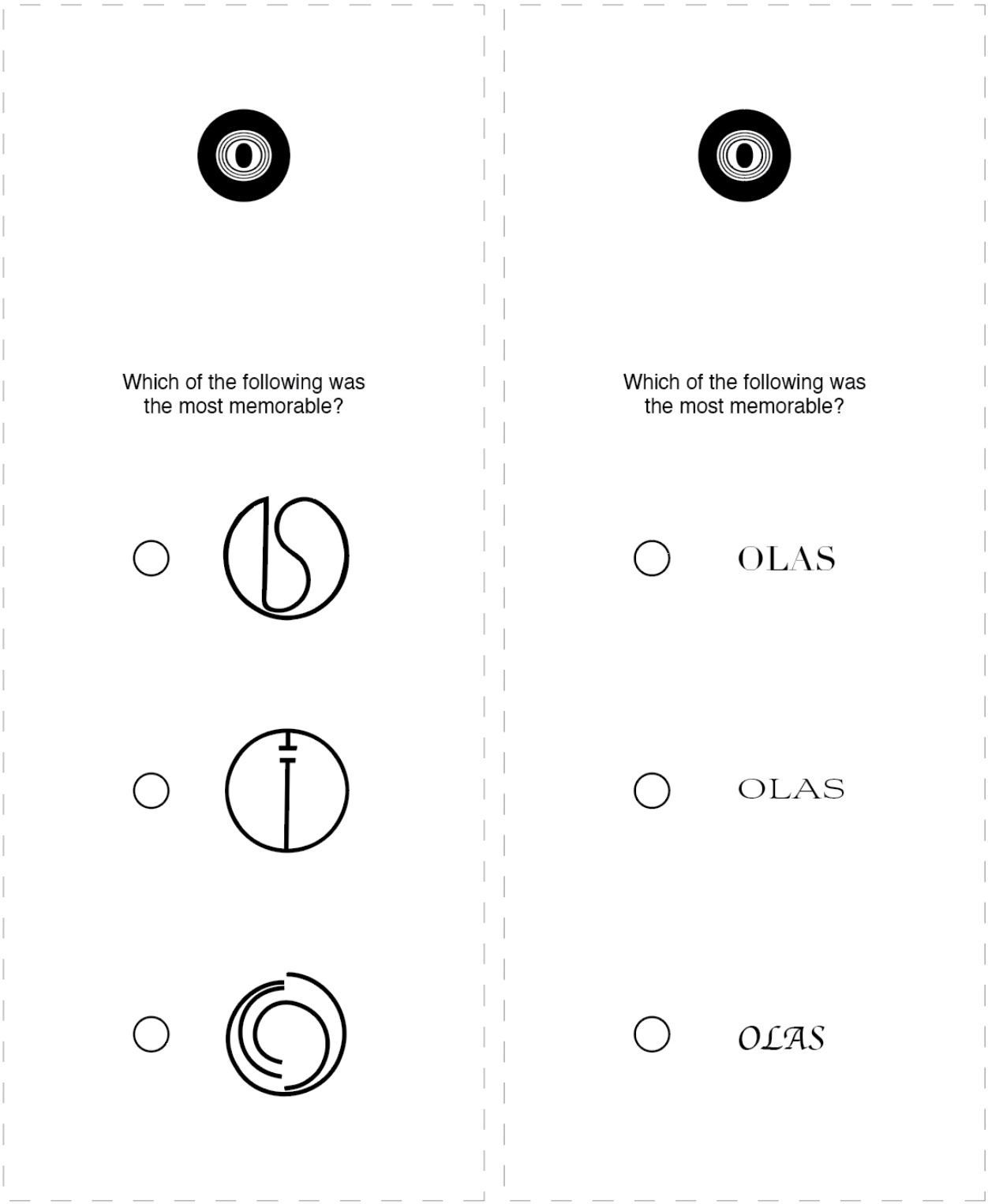

Figure 3.6 Answer Keys. Monica Suarez Argudin. 2023

After filling out the forms, they were thanked for participating and reminded about the follow-up survey a week after. At the end of every experiment, the moderator did archive the two answer-key and the demographic and contact information together for reading the results. The consent forms were stored in a separate secured envelope. The study displayed three symbols in total and three typefaces. To test each visual element and to obtain accurate results on the influence of the smell, the experiment was divided into three groups A, B, and C (Figure 3.7). Each group had the smell included in a different visual, but all had the same procedure; the last card of each set was the one scented. Ten people were tested on day one, and the remaining fourteen were concluded on day two. During both sessions, the test was conducted first to group A, then to group B, and last, to group C.

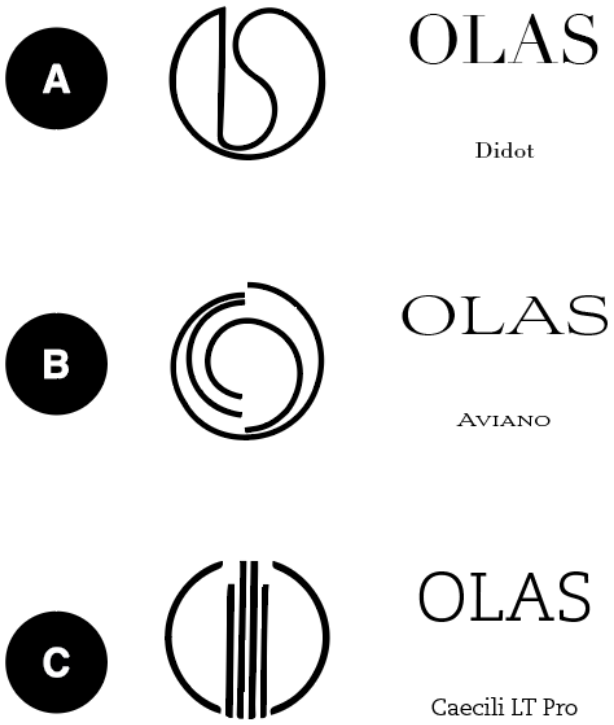

Figure 3.7 Scent Distribution by Groups. Monica Suarez Argudin. 2023

3.2 Organizing the Data

I used the statistical analysis fixture provided by SurveyMonkey to evaluate the data. Also, I created infographics to identify patterns and trends. I reviewed the demographic characteristic of the participants in each group to see if differences could influence the study results. The outcomes from the in-person section were examined by groups and then all together. The same steps were taken for the follow-up questionary. After gathering all the data from both sections, I established an overall review considering short and long-term memory to understand the accuracy of the recollections of information with the presence of smell.

4 RESULTS

4.1 In-Person Data

In group A, 62.50% of participants were female, and 37.50% were male. Their age ranged from 18 to 21 years old. The scented symbol presented 62.50% of recollection; the second symbol, incorporated for testing error recollection, had a 12.50%, and the third symbol had a 25.00% of reactions (Figure 4.1). In contrast, the typefaces had a 12.50% response for the scented card, while the one without had an 87.50% reaction; the one placed for error recollection had 0.00% of recollection (Figure 4.2).

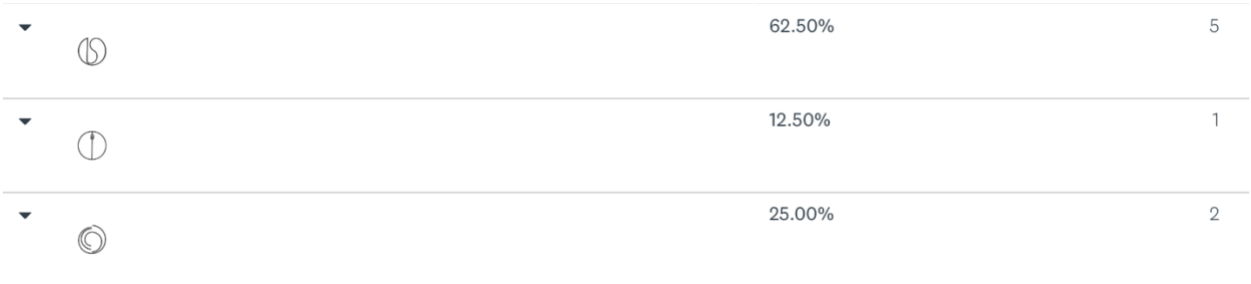

Figure 4.1 Group A In-person. Symbols Data. Monica Suarez Argudin. 2023

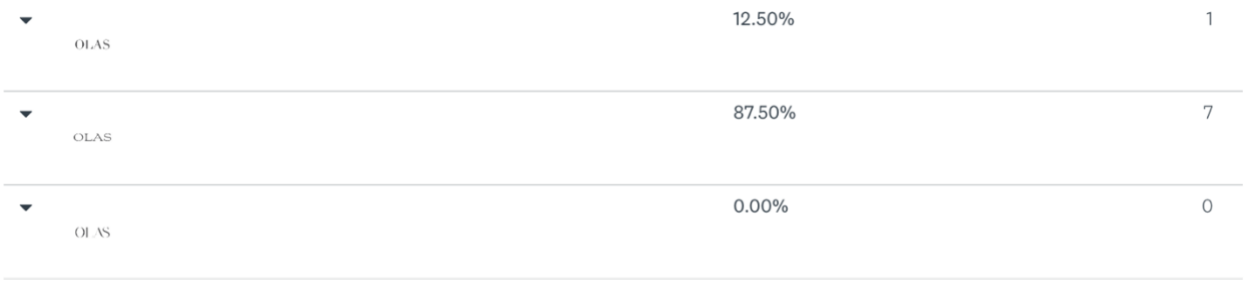

Figure 4.2 Group A In-person. Typefaces Data. Monica Suarez Argudin. 2023

Group B had a 62.50% of female participants and 37.50% of males. Their age ranged from 18 to 25 years old. In the symbol exercise, this group presented 50.00% of recollection for the scented one and 50.00% of selection for the unscented symbols. The symbol placed for error recollection had a 0.00% reaction (Figure 4.3). The performance of typefaces was 37.50% for the one with fragrance, 50% for the one without, and 12.50% selected the type included for testing error recollection (Figure 4.4).

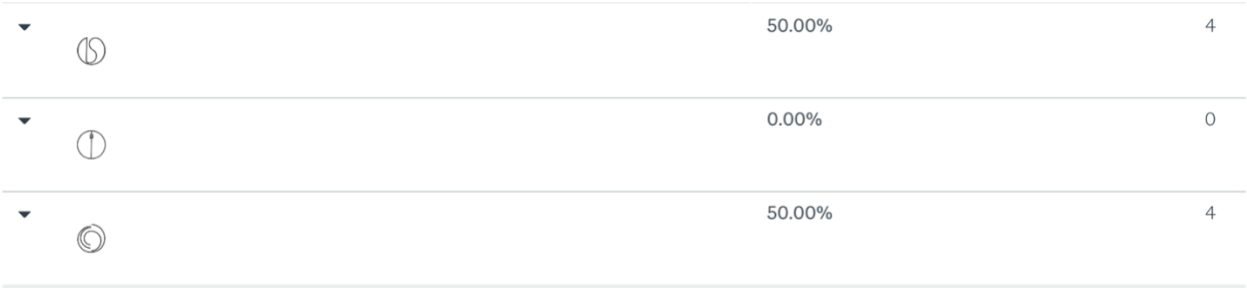

Figure 4.3 Group B In-person. Symbols Data. Monica Suarez Argudin. 2023

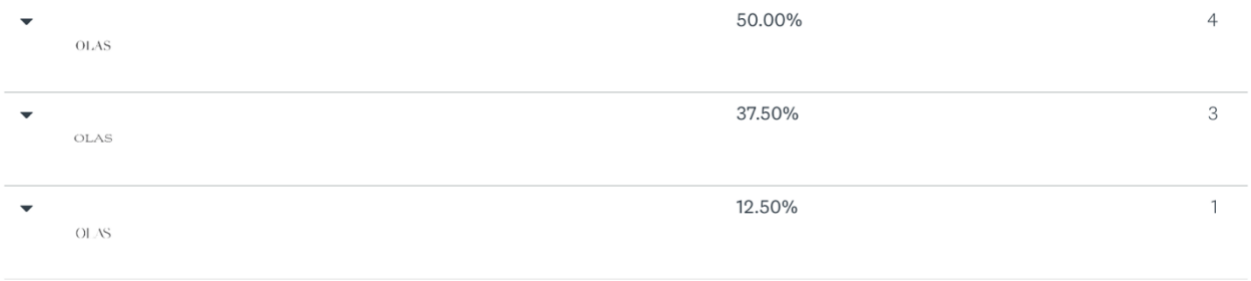

Figure 4.4 Group B In-person. Typefaces Data. Monica Suarez Argudin. 2023

Group C had 50.00% of female participants and 50.00% of males. Their ages ranged from 18 to 28 years old. This group had a 75.00% recollection of the scented symbol, 25.00% of the one without smell, and the one place for error recollection had a 0.00% reaction (Figure 4.5). The typefaces had a 12.50% of response for the scented one, 87.50% for the unscented one, and 0.00% for the error recollection option (Figure 4.6).

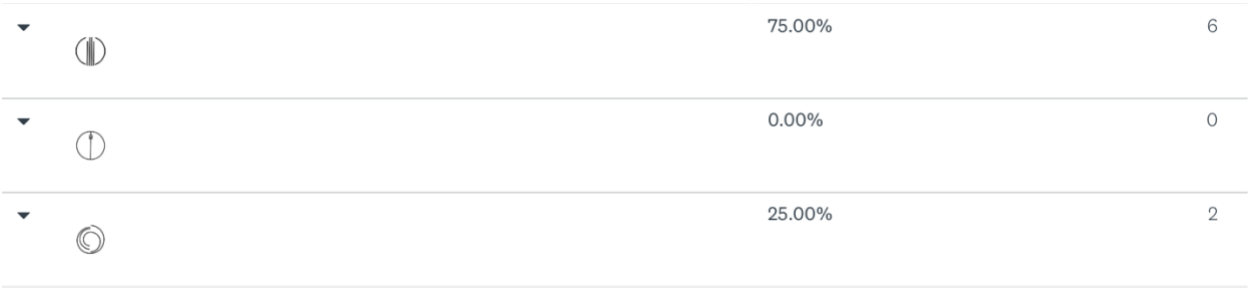

Figure 4.5 Group C In-person. Symbols Data. Monica Suarez Argudin. 2023

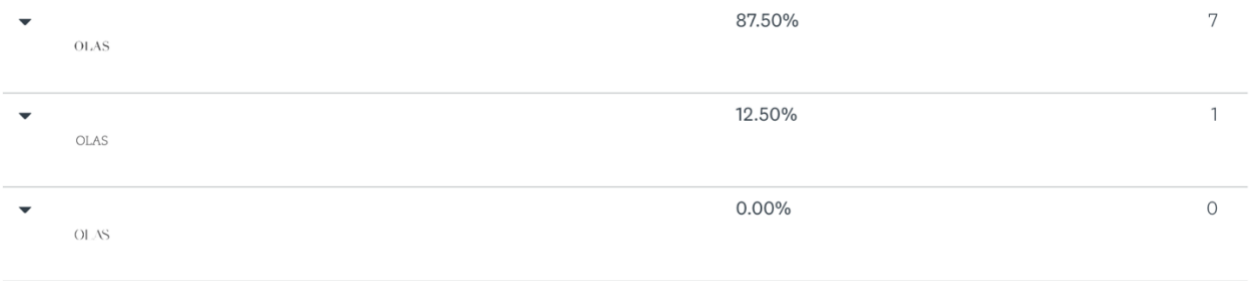

Figure 4.6 Group C In-person. Typefaces Data. Monica Suarez Argudin. 2023

Overall, there was a significant difference between the results of the symbols and the typefaces in the in-person exercise. The symbols experiment showed that 62.5% of participants selected the designs with smell and 37.5% the unscented ones. In comparison, the typefaces displayed that 20.8% chose the one with smell and 79.2% without.

4.2 Follow-up Data

In group A, there was a participation of 5 people from the initial 8 participants. The involvement of females was 80.00%, while the males had 20.00%. Their age ranged from 18 to 21 years old. The scented symbol presented 80.00% of recollection; the second symbol, incorporated for testing error recollection, had a 0.00%, and the third symbol had a 40.00% of reactions (Figure 4.7). In contrast, the typefaces had a 0.00% response for the scented card, while the one without had a 100.00% reaction; the one place for error recollection had 0.00% of recollection (Figure 4.8).

ANSWER CHOICES	RESPONSES	
	80.00%	4
	0.00%	0
	40.00%	2
Total Respondents: 5		

Figure 4.7 Group A Follow-up. Symbols Data. Monica Suarez Argudin. 2023

ANSWER CHOICES	RESPONSES	
	0.00%	0
	100.00%	5
	0.00%	0
TOTAL		5

Figure 4.8 Group A Follow-up. Typefaces Data. Monica Suarez Argudin. 2023

Group B had a participation of 7 people from 8 original participants. The involvement of females was 57.14%, while males had 42.86% participation. Their age ranged from 18 to 25 years old. In the symbol exercise, this group presented 57.14% of recollection for the scented one and 42.86% of selection for the unscented symbols. The symbol placed for error recollection had a 0.00% reaction (Figure 4.9). The performance of typefaces was 71.43% for the one with fragrance, 28.57% for the one without, and 0.00% selected the type included for testing error recollection (Figure 4.10).

ANSWER CHOICES	RESPONSES	
	42.86%	3
	0.00%	0
	57.14%	4
Total Respondents: 7		

Figure 4.9 Group B Follow-up. Symbols Data. Monica Suarez Argudin. 2023

ANSWER CHOICES	RESPONSES	
	28.57%	2
	71.43%	5
	0.00%	0
TOTAL		7

Figure 4.10 Group B Follow-up. Typefaces Data. Monica Suarez Argudin. 2023

Group C had a participation of 7 people from 8 original participants. The involvement of females was 57.14%, while the males had 42.86%. This group had an 85.71% recollection of the scented symbol, 42.86% of the one without smell, and the one place for error recollection had a 0.00% reaction (Figure). The typefaces had a 28.57% response for the scented one, 71.43% for the unscented one, and 0.00% for the error recollection option (Figure).

ANSWER CHOICES	RESPONSES	
	85.71%	6
	0.00%	0
	42.86%	3
Total Respondents: 7		

Figure 4.11 Group C Follow-up. Symbols Data. Monica Suarez Argudin. 2023

ANSWER CHOICES	RESPONSES	
	71.43%	5
	28.57%	2
	0.00%	0
TOTAL		7

Figure 4.12 Group C Follow-up. Typefaces Data. Monica Suarez Argudin. 2023

Overall, there was a significant difference between the results of the symbols and the typefaces in the follow-up exercise. The symbols experiment showed that 74% of participants selected the designs with smell and 26% the unscented ones. In comparison, the typefaces displayed that 36% chose the one with smell and 64% without.

4.3 General Evaluation

The study results generally showed no significant difference in the recollection of scented visual information between genders. The age range did not highlight notable differences either. However, the smell had a considerable influence on the memory of symbols. In a general evaluation including the results of in-person and follow-up responses, the symbols had a total recollection of 67%, while scented typefaces only had a 28%. An interesting fact about the

collected data showed that the follow-up exercise had an increased recollection of the scented symbols. Also, the typefaces exercise showed some improvement in the recollection results in at least two of the shown typefaces.

5 EXHIBITION

The exhibition presented the study's methodology and its results. It also offered an immersive experience, combining the olfactory and visual senses so that visitors could feel first-hand how their brains respond to combined stimuli. Each artwork functioned as a lamp, representing neural electricity. The first piece was an abstract neural representation that highlighted the areas of the brain where the olfactory, memory, and visual stimuli are processed (Figure 5.1). These three areas of the brain were intertwined by threads that connected to bottles containing rose oil. (Figure 5.2) This work artistically synthesized the content of my thesis for gallery visitors.

Figure 5.1 Olfactory Waves. Monica Suarez Argudin. 2023

Figure 5.2 Rose Oil. Monica Suarez Argudin. 2023

Infographics installed against the back gallery wall showcased the statistics of the visual elements that contained the aroma; these were designed in a round shape and are inscribed in the pupil of an eye to reinforce the visual element. Red tones were applied across the designs to represent the inclusion of the aroma, but each had a different treatment depending on the results of the exercises. In the case of the symbols, the application of the red color was more remarkable since this data shows how the influence of aroma helps to retain these visual elements (Figure5.3). The central infographic represents the data collected in general and also shows the demographic makeup of the study's participants (Figure 5.4).

Figure 5.3 Scented Symbols and Typefaces. Monica Suarez Argudin. 2023

Figure 5.4 General Infographic. Monica Suarez Argudin. 2023

A mural completed this installation. This mural featured the project's logo in its red version (Figure), repeated in rows and columns, to create a large geometric grid. Each logo was scented with the rose fragrance, helping spread the smell through the gallery. This piece provoked an exciting response from viewers; they got closer to the artwork to better inhale the aroma, and some visitors even asked if they could touch the piece. This reaction suggests that when more than one sense is stimulated, people may want to experience the stimulation of even more senses.

Figure 5.5 Study Mural. Monica Suarez Argudin. 2023

The exhibition also displayed the study materials so that viewers could interact with them. The results of an EEG experiment were installed directly above the study materials. These results were from an EEG session I conducted on myself in an attempt to visually understand the involuntary brain stimulation that happens while looking and smelling (Figure 5.6). This section included a design solution as an example of how the study findings could be incorporated into a practical application. The designed solution was a series of bookmarks with different cultural

symbols containing the rose fragrance to promote and expand cultural awareness of symbology through the aroma.

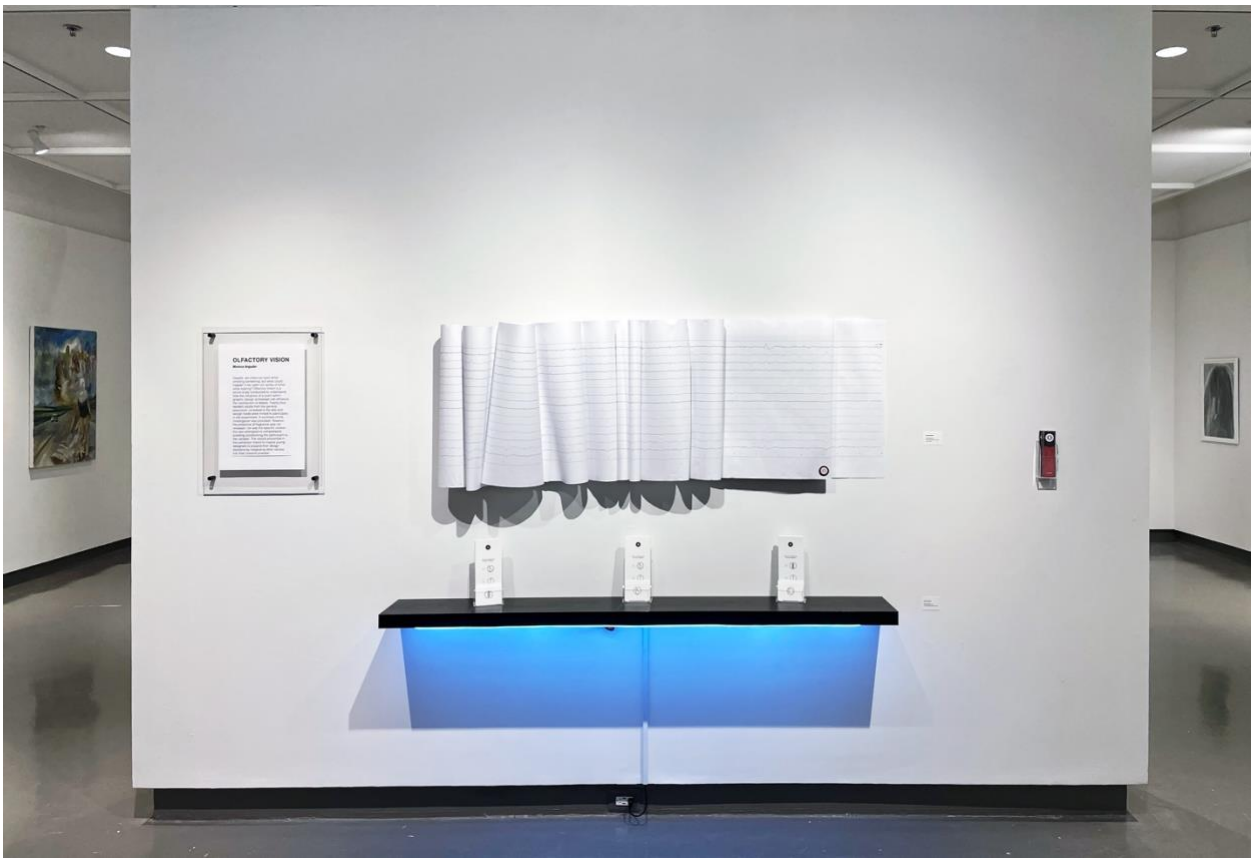

Figure 5.6 The Study, EEG Results, and Design Solution. Monica Suarez Argudin. 2023

6 CONCLUSIONS

In conclusion, the study results showed that combining the sense of smell with certain visual information could improve communication and influence the viewers' memory, in this case, symbols. From the point of view of the design process, the handling of fragrances and the techniques for their application have been the most challenging part of the study, as well as the ways to include them within the works of art for the exhibition. In this project, I was able to achieve the inclusion of smell by applying simple and time-tested techniques, such as the use of fiber paper and the application of rose oil. Multiple tests, however, were necessary for controlling the oil and its placement within the layout; further research is essential to develop more effective techniques for integrating smells into art and design. Overall and keeping in mind the reactions and feedback during the exhibition's reception, people are stimulated by the inclusion of smell in the fine art setting. During the art show, many visitors complimented the fragrance as it wafted into the surrounding areas; some people even admitted that the scent was the main reason they entered the gallery.

During the development of this thesis, I expanded my knowledge of not only ways of communication but also the importance of challenging our creative process. In the future, I plan to include an EEG device as a primary tool to comprehend involuntary reactions and I may test different applications within graphic design, such as colors, shapes, and figures. Also, the idea of expanding the experiment to include other senses like touch and taste would be very valuable; these findings could provide helpful insights into how different sensory experiences can impact memory and communication.

BIBLIOGRAPHY

Altay, B. (2017). Multisensory Inclusive Design Education: A 3D Experience. *The Design Journal*, 821-846. Retrieved from https://doi.org/10.1080/14606925.2017.1371949

Bates, C. (2021, July 11). *Why chocolate's smell is more important than its taste.* Retrieved from Wekiva culinary: www.wekivaculinary.org/chocolates-enticing-aroma/

Bradstreet, C. (2022). *Scented Vision. Smell in Art, 1850-1914.* Pennsylvania: The Pennsylvania State University Press.

Brownlee, J. (2006). *A brief history of Smell-O-Vision.* Retrieved from WIRED: https://www.wired.com/2006/12/a-brief-history-2-2/

Brun, J.-P. (2000). *The production of perfumes in antiquity: The cases of Delos and Paestum.* American Journal of Archaeology.

Chaudhri, N. K. (2009). *History of cosmetics*. Retrieved from Asian Journal of Pharmaceutics (AJP): www.asiapharmaceutics.info/index.php/ajp/article/view/260/121

Cytowic, R. (2018). *Synesthesia.* Massachusetts: The MIT Press.

Decker, E. (2019). *Breathe in: The neuroscience of scent.* Retrieved from International Arts + Mind Lab (IAM Lab): https://www.artsandmindlab.org/the-neuroscience-of-scent/

Faller, M. (2021). *Health digest.* Retrieved from https://www.healthdigest.com/490769/the-real-reason-its-harder-to-smell-yourself/

Gilbert, Avery N (2008). *What The Nose Knows: The Science of Scent in Everyday Life.* New York: Crown Publishers.

Grosofsky, A. (2011). An exploratory investigation of coffee and lemon scents and odor Identification. *SAGE journals*. Retrieved from https://doi.org/10.2466/24.PMS.112.2.536-538

Grossenbacher, P. (2001). Mechanisms of synesthesia: cognitive and physiological constraints. *TRENDS in Cognitive Sciences*. Retrieved from https://doi.org/10.1016/S1364-6613(00)01571-0

Hassenfeld, N. (Host). (2022, March 23) Making Sense: The Umami Mama [Audio Podcast Episode] In *Unexplainable.* Vox. Retrieved from https://www.vox.com/unexplainable

Herz, R. S. (2011). *Neurobiology of sensation and reward.* Chapter 17. Perfume Quality and Art Retrieved from https://www.ncbi.nlm.nih.gov/books/NBK92802/

Herz, R. S. (2016). The role of odor-evoked memory in psychological and physiological health. *Brain Sciences*, 13.

Kornmeier, J., Neuman, F. & Oberhauser, V. (2020). *Scientific reports*. Retrieved from https://www.nature.com/articles/s41598-020-57613-7#citeas

Mclean, K., Henshaw, V., Medway, D., Perkins, C., & Warnaby, G. (2018). *Designins with smell*. New York: Routledge.

Meggs, P. &. Purvis, A. (2016). *History of Graphic Design.* New Jersey: WILEY.

Müeller, J. &. Wiedemann, J. (2021). *The history of Graphic Design. 1890-1959.* Italy: TASCHEN.

Newman, T. (2020). *Medical news today*. Retrieved from https://www.medicalnewstoday.com/articles/using-scents-to-boost-learning-during-sleep

Nikolic, P., & Cheok, A. (2020). Using Interactive and Multisensory Interfaces to Design Behavioral Change. *InnerBody*, 128–134. Retrieved from https://doi.org/10.1162/leon_a_01720

Olofsson, J., Niedenthal, S., Ehrndal, M., Zakrzewska, M., Wartel, A., & Larsson, M. (2017). Beyond Smell-O-Vision: Possibilities for Smell-Based Digital Media. *Simulation & Gaming*, 455–479. Retrieved from https://journals.sagepub.com/doi/10.1177/1046878117702184

Olofsson, J., Ekström, I., Lindstrom, J., Syrjanen, E., Stigsdotter-Neely, A., Nyberg, L., Jonsson, S., & Larsson, M. (2020). Smell-Based Memory Training: Evidence of Olfactory Learning and Transfer to the Visual Domain. *OXFORD*, 593–600. Retrieved from https://doi.org/10.1093/chemse/bjaa049

Polak, O. (2014). *Deisgnboom*. Retrieved from https://www.designboom.com/project/s-sense/

Polak, O. (2014). *S-sense. Smell as a design tool*. Retrieved from https://www.omerpolak.com/ssense

Pursey, T. &. Lomas, D. (2018). Tate Sensorium: an experiment in multisensory immersive design. *THE SENSES AND SOCIETY*, 354–366. Retrieved from https://doi.org/10.1080/17458927.2018.1516026

Quercia, D., Schifanella, R., Aiello, L., & Mclean, K. (2015). Smelly Maps: The Digital Life of Urban Smellscapes. *Association for the Advancement of ArtificialIntelligence*. Retrieved from https://ojs.aaai.org/index.php/ICWSM/article/view/14621/14470

Rit, M., Croijmans, I., & Speed, L. (2019). High-Tempo and Stinky: High Arousal Sound–Odor Congruence Affects Product Memory. *BRILL*, 347–366. Retrieved from https://brill.com/view/journals/msr/32/4-5/article-p347_4.xml

Spence, C. (2020). Scent and the cinema. I-Perception, 11(6). *SAGE journals.* Retrieved from https://doi.org/10.1177/2041669520969710

Tamminen, J., & Mebude, M. (2019). Reinstatement of odour context cues veridical memories but not false memories. *Routledge*, 575–579. Retrieved from https://doi.org/10.1080/09658211.2018.1513041

Traverso, V. (2017). *Learning About Cities by Mapping Their Smells.* Atlas Obscur*a.* Retrieved from https://www.atlasobscura.com/articles/art-mapping-smell-smellscapes-kate-mclean

Ward, J. (2012). Synesthesia. *Annual Review of Psychology*, 49-75. Retrieved from https://doi.org/10.1146/annurev-psych-113011-143840

Willander, J. (2006). Smell your way back to childhood: autobiographical odor memory. *Psychonomic Bulletin & Review 13*, 240–244. Retrieved from https://pubmed.ncbi.nlm.nih.gov/16892988/