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THE ROLE OF MULTISENSORY EXPERIENCES ON SHORT-TERM
ON MEMORY RETENTION IN SIMULATED CAFE ENVIRONMENTS

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THE ROLE OF MULTISENSORY EXPERIENCES ON SHORT-TERM MEMORY RETENTION IN SIMULATED CAFE ENVIRONMENTS

A Master's Thesis

by
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Ankara
May 2025

To my universe, my guiding star, my dearest mother,

Nilgün Nazzal



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RETENTION IN SIMULATED CAFE ENVIRONMENTS

The Graduate School of Economics and Social Sciences
of
İhsan Doğramacı Bilkent University

by

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ANKARA

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By Nil Nazzal

I certify that I have read this thesis and have found that it is fully adequate, in scope and in quality, as a thesis for the degree of Master of Fine Arts, Department of Interior Architecture and Environmental Design.

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ABSTRACT

THE ROLE OF MULTISENSORY EXPERIENCES ON SHORT-TERM MEMORY RETENTION IN SIMULATED CAFE ENVIRONMENTS

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This study investigates how multisensory experiences can enhance short-term memory retention in public interiors, specifically cafes. Previous research has highlighted and emphasized the cognitive benefits of multisensory integration in various settings, including educational institutions and museums. However, there has been limited exploration of memory retention in cafe environments. This research examines the effects of visual, auditory, and olfactory stimuli, both individually and simultaneously, addressing a significant gap in understanding how sensory design influences memory performance in public spaces. A mixed-method experimental design was employed involving 76 adults residing in Ankara, Türkiye. Participants completed a demographic questionnaire and two baseline tests before being randomly assigned to one of four sensory groups: visual, visual and auditory, visual and olfactory, and visual, auditory, and olfactory. The experiment was conducted in a controlled indoor environment that simulated a cafe-like setting. Participants were then given a distraction puzzle followed by an open-ended memory retention task. Qualitative data were analyzed using content analysis and matrix layout, while quantitative data were analyzed using descriptive statistics, independent t-tests, one-way ANOVA, and *Pearson's* correlation. The findings indicate that multisensory experiences significantly enhance memory retention compared to single or dual-

sensory modalities. Additionally, cognitive assessments showed a low positive correlation with memory retention. This research provides important insights into multisensory design in public spaces, aiming to foster the development of more memorable, cognitively engaging, and experiential environments.

Keywords: Cafe Environments, Memory Retention, Multisensory Design, Short-term Memory



ÖZET

SİMÜLE EDİLMİŞ KAFE ORTAMLARINDA ÇOKLU DUYUSAL DENEYİMLERİN KISA SÜRELİ BELLEK TUTULUMU ÜZERİNDEKİ ROLÜ

Nazzal, Nil

İç Mimarlık ve Çevre Tasarımı Yüksek Lisans Programı

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Bu çalışma, kamu iç mekanlarında, özellikle kafelerde çoklu duyuşsal deneyimlerin kısa süreli bellek tutulumunu artırmadaki rolünü araştırmayı amaçlamaktadır. Önceki araştırmalar, eğitim kurumları ve müzeler gibi çeşitli ortamlarda çoklu duyuşsal entegrasyonun bilişsel faydalarına vurgu yapmıştır. Bu durum, hem bellek hem de kafeler konusunda henüz yeterince incelenmeyen alanların araştırılması gerektiğini ortaya koymaktadır. Görsel, işitsel ve koku duyuşsal uyaranlarının, hem tekil hem de eşzamanlı olarak etkileri incelendiğinde, bu araştırma, toplu alanlarda duyuşsal tasarımın bellek performansları üzerindeki etkisini anlamada önemli bir boşluğu ele almaktadır. Buna uygun olarak, Ankara, Türkiye'de ikamet eden 76 yetişkin ile karma bir yöntem deneysel tasarımı uygulanmıştır. Demografik anket ve iki temel testin tamamlanmasının ardından, eşit sayıda katılımcı rastgele olarak dört duyuşsal gruba (görsel, görsel ve işitsel, görsel ve kokusal, ve görsel, işitsel, kokusal) atanmıştır. Kontrollü bir iç mekan ortamında gerçekleştirilen deneyde, kafeye benzeri bir ortam yapılarak belirli duyuşsal koşullar sunulmuş, ardından dikkat dağıtıcı bir bulmaca ve açık uçlu bellek tutulum görevi yapılmıştır. Nitel veriler içerik analizi ve matris düzeni ile analiz edilirken, nicel veriler betimsel istatistikler, bağımsız t-testleri, tek yönlü varyans analizi ve Pearson korelasyonu ile analiz edilmiştir. Bulgular, çoklu duyuşsal deneyimlerin, tekli veya ikili duyuşsal modlara kıyasla bellek

tutulumunu yüksek ve anlamlı bir şekilde pozitif yönde etkilediğini ortaya koymaktadır. Ayrıca, bilişsel değerlendirmeler, bellek tutulumuyla düşük düzeyde pozitif bir korelasyon göstermiştir. Bu araştırma, kamu alanlardaki çoklu duyusaltasarım üzerine yapılan araştırmaları genişleterek, daha hatırlanabilir, bilişsel olarak etkileyici ve deneyimsel ortamların yaratılmasını teşvik etmeyi amaçlayan kritik bilgiler sunmaktadır.

Anahtar Kelimeler: Bellek Tutulumu, Çoklu Duyusal Tasarım, Kafe Ortamları, Kısa Süreli Bellek



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ABBREVIATIONS

LTM: Long-Term Memory

MAAS: Mindful Attention Awareness Scale

MoCA: Montreal Cognitive Assessment

MoMA: Museum of Modern Art

SAD: Seasonal Affective Disorder

SBS: Sick Building Syndrome

SM: Sensory Memory

STM: Short-Term Memory

CHAPTER I

INTRODUCTION

Public spaces are essential for maintaining the public realm (Mehta, 2013). There is a growing recognition that high-quality public spaces are vital for the social and psychological well-being of contemporary communities. Effective public spaces are characterized by inclusivity, responsiveness, and thoughtful design. Around the world, new public spaces are being introduced, and traditional ones are being adapted to meet modern demands (Mehta, 2013). These public spaces include educational and health institutions, museums, and restaurants or cafes, all of which influence individuals' experiences and memories. They play a crucial role as sensory, social, and mental environments that encourage both social interaction and individual engagement.

Among these, cafes stand as unique public spaces that offer a balance between social interaction and personal retreat. Often referred to as 'third places,' distinct from the home and workplace, cafes foster a sense of informal belonging and community (Oldenburg, 1999). Their popularity stems from their ability to provide accessible yet intimate environments that encourage both socialization and cognitive engagement (Waxman, 2006; Widyaningsih et al., 2021). Through appropriate spatial design, cafes can make a meaningful contribution to urban life, creating spaces where people can gather, work, and relax (Waxman, 2006).

Modern architecture often emphasizes visual design, which can lead to the neglect of other sensory modalities, such as auditory and olfaction experiences that are essential for enhancing our spatial experiences (Pallasmaa, 2012). Heilig (1992) established a

hierarchy of the senses based on their ability to capture attention, attributing 70% to vision, 20% to hearing, 5% to smell, 4% to touch, and 1% to taste. This visual dominance is further emphasized by the fact that a significant portion of the brain is dedicated to processing visual information compared to inputs from other senses (Hutmacher, 2019; Gallace et al., 2012). As a result, many architects and designers have primarily focused on visual elements, often designing with vision as their sole priority (Corbusier, 1991; Mau, 2018). However, research shows that integrating multisensory modalities, such as auditory and olfactory elements, into environments enhances cognitive stimulation by activating different neural functions (Malhotra & Abrol, 2024). Early research in cognitive science revealed that multisensory experiences enhance memory formation by engaging various neural pathways. This concept is supported by foundational theories, including the multi-store memory model (Atkinson & Shiffrin, 1968), dual coding theory (Paivio, 1986), and multisensory integration theory (Ayres, 1979). The presence of multisensory stimuli adds complexity and richness to the information stored in our memory (Shams & Seitz, 2008).

Research has shown that memory functions more effectively when multiple sensory modalities are engaged rather than relying on just one (Meyerhoff & Huff, 2016; von Kriegstein & Giraud, 2006). Studies conducted in public spaces such as educational institutions, therapeutic environments, and museums have shown that integrating various sensory inputs leads to improved cognitive outcomes (Chan et al., 2005; Habbak & Khodeir, 2023; Lillard, 2008). For example, this understanding has been applied in early educational approaches, such as the Montessori method, to enhance memory retention (Montessori, 1912; Lillard, 2008).

Although there is increasing recognition of the importance of multisensory design, there is still a significant lack of technical literature examining its empirical effects in specific settings, such as cafes, particularly regarding its impact on memory retention. This study aims to address this gap by thoroughly exploring multisensory experiences in cafe environments and their influence on memory retention and recall.

1.1 Problem Statement

There is increasing theoretical and experimental evidence supporting the concept of multisensory engagement; however, there remains a significant gap in its applications to public spaces, such as cafes. Current design practices for modern public spaces tend to prioritize visual elements and aesthetics, often overlooking other sensory dimensions, including olfactory and auditory experiences (Pallasmaa, 2012). Research indicates that engaging multiple senses enhances memory retention and recall by activating different neural pathways, which enriches the stored information (Meyerhoff & Huff, 2016; Shams & Seitz, 2008; von Kriegstein & Giraud, 2006; Woods & Newell, 2004). While there are studies on multisensory approaches in broader contexts, such as museums and educational spaces, their integration into cafes remains largely unexplored. This integration is essential for understanding how multisensory design can enhance memory retention and create more memorable spaces. Addressing this gap is crucial for advancing the design of public spaces to improve functionality, aesthetics, and cognitive and emotional engagement.

1.2 Aim and Scope

This study holds both theoretical and practical significance, as it investigates the role of multisensory experiences in memory retention within public interior settings. By exploring how the integration of various sensory modalities, such as visual, auditory, and olfactory, enhances an individual's ability to retain knowledge in everyday public spaces, the study goes beyond established cognitive models.

The objectives will be achieved through a systematic search, as well as qualitative and quantitative analysis, alongside the synthesis of existing literature and experimental results. Practically, the findings will provide evidence-based guidance and insights for stakeholders to enhance social interaction and cognitive stimulation in public spaces. By systematically examining the effects of visual, auditory, and olfactory stimuli, both individually and collectively, the study aims to contribute to the formation of more effective and memorable public environments that cater to individuals' sensory and cognitive needs.

Based on the gap in the literature and the objectives of the study, the following research questions and hypotheses were addressed.

RQ1: Do multisensory cafe experiences result in higher memory retention than single-sensory environments?

RQ2: Which specific combinations of sensory modalities (e.g., visual and auditory, visual and olfactory, visual, auditory, and olfactory) create the most significant enhancement in memory retention?

RQ3: Is there a relationship between memory and attention tests and individuals' responses to multisensory experiences in cafes?

H1: Multisensory experiences in cafes will lead to significantly higher memory retention compared to single-sensory environments.

H2: Combining visual, auditory, and olfactory stimuli will result in the most significant enhancement of memory retention compared to dual-sensory combinations.

H3: Higher levels of memory and attention tests will correlate positively with higher memory retention response to multisensory experiences in cafes.

1.3 Structure of the Thesis

This thesis is organized into six chapters to provide a clear portrayal of the research process and findings. Following the introductory chapter, Chapter 2 provides a comprehensive review of the existing literature. It outlines the theoretical frameworks surrounding multisensory design in public spaces, memory retention, and the impact of various senses on memory.

Chapter 3 details the research methodology and the structure of the experimental design, including information about the participants, the experimental setting, data collection instruments, and data analysis techniques.

In Chapter 4, the results of the research are presented, integrating both qualitative and quantitative analyses. These findings are presented through statistical tables.

Chapter 5 provides a critical discussion of the results, establishing connections between the data collected and existing studies.

Finally, the concluding chapter addresses the limitations of the study, suggests directions for future research, and discusses practical implications. The thesis is followed by references and appendices, which include questionnaires, raw data, and additional information. Together, these chapters offer a comprehensive understanding of how multisensory design enhances memory retention, contributing valuable insights to both academic and professional fields.



CHAPTER II

LITERATURE REVIEW

2.1 Theoretical Framework

This thesis considers three vital theoretical models linked to the study's main objectives. The three theories are the multi-store memory model, multisensory integration theory, and dual coding theory. The multi-store memory model serves as a critical framework for how the sensory input is neurologically processed through the phases of memory (Atkinson & Shiffrin, 1968). The dual coding theory further elaborates on encoding multisensory information in distinct channels and their impact on memory retention (Paivio, 1986). Lastly, the multisensory integration theory emphasizes the importance of effective sensory information and its impact on perception, behavior, and cognitive functions (Ayres, 1979). **Figure 1** illustrates the differences and connections between the three theoretical frameworks.

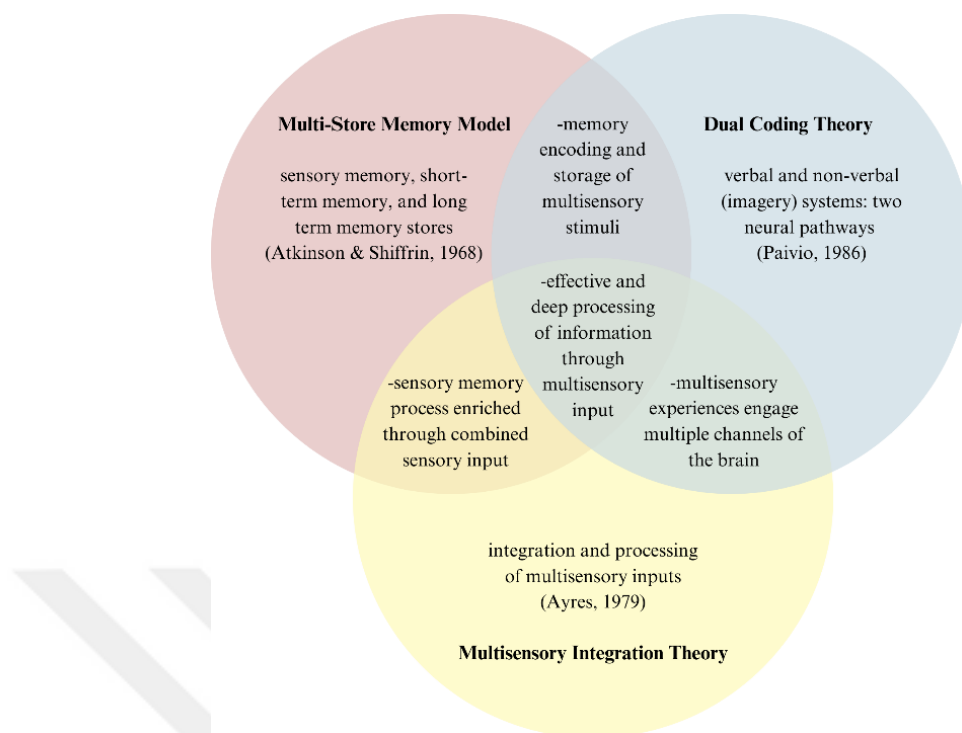


Figure 1. Comparison of the Three Theoretical Frameworks

2.1.1 Multi-Store Memory Model

The multi-store memory model, proposed by Atkinson and Shiffrin (1968), suggests that memory consists of three stores. The three stores are sensory memory (SM), short-term memory (STM), and long-term memory (LTM) (Atkinson & Shiffrin, 1968). Each store has its unique characteristics regarding capacity, duration, and encoding. SM serves as the initial stage of the process, where the senses capture information from the environment. A large amount of sensory input is received and filtered quickly. The information that attracts attention is processed into STM, where limited information is retained briefly. If the information is rehearsed, it moves further into LTM to be stored indefinitely. The encoding in LTM is based on semantics, meaning, and significance. Moreover, the encoding process occurs in three main ways: visual, acoustic, and semantic (Atkinson & Shiffrin, 1968). Since SM acts as the first stage of memory, where sensory modalities are stored for processing, this theory provides a foundation for the impact of multisensory experiences on memory (Atkinson & Shiffrin, 1968).

2.1.2 Dual Coding Theory

Dual Coding Theory is a theory of cognition hypothesized by Allan Paivio. This theory suggests that the human brain processes information utilizing two distinct and interconnected systems, the verbal and non-verbal (imagery) (Paivio, 1986).

According to Paivio (1986), information encoded through the two channels is more likely to be remembered due to the two paths for retrieval. This theory supports multisensory experience by emphasizing the vitality of engaging multiple sensory modalities to create more robust memory traces (Paivio, 1986).

2.1.3 Multisensory Integration Theory

The Multisensory Integration Theory was founded by Ayres (1979), who explained the brain's process of forming a coherent perception of an environment. This formulation involves processing sensory information like sight, sound, and smell. It puts forth that the effective integration of sensory modalities allows more adaptive responses to an environment. Such sensory processing is crucial in perceiving and responding to sensory stimuli and its impact on emotions, behavior, and cognitive functions (Ayres, 1979; Chandrasekaran, 2017).

2.2 Cafe Environments

Public spaces play a crucial role in urban life, serving as places for social interactions, gatherings, and community engagement (Noaime et al., 2025). Among these spaces, cafes hold a particularly important position. Often referred to as a 'third places,' cafes act as informal settings outside of homes and workplaces that promote socialization, relaxation, and cognitive engagement (Oldenburg, 1999; Waxman, 2006). They provide unique environments that are both publicly accessible and personally inviting, allowing diverse individuals to connect and interact (Bodkin, 2023; Widyaningsih et al., 2021)

The physical design and layout of a cafe aim to enhance visibility, increase sales, and promote social interactions. Accordingly, Waxman observed and interviewed customers at three cafes located in Nashville, Tennessee (2006). She assessed place

attachment related to cafes by triangulating data from interviews, observations, and visual analysis, enabling her to identify specific preferred physical characteristics.

According to the findings, “the top five characteristics of the ideal coffee shop included cleanliness, aroma, adequate lighting, comfortable furniture, and a view to the outside” (Waxman, 2006, p. 42-43). Cleanliness was identified as the most important feature in cafe design, with material choices playing a crucial role in maintaining a tidy environment. The second most important factor was the smell of coffee and baked goods, which enhanced the cafe’s atmosphere. Good lighting was essential, particularly for reading and studying, with preferences varying by age and the amount of natural light available.

Customers also expressed a desire for comfortable seating and views of the exterior, which positively contributed to the cafe's ambiance. People preferred seats located near walls, fixed architectural elements, and corners for more privacy. Additionally, groups appreciated the flexibility to combine two tables for larger gatherings (Waxman, 2006).

A study conducted by Bilgiç and Şahin (2021) explored the influence of cafes on user experiences through visual perception and personal impressions. The research analyzed various architectural elements, including lighting, materials, spatial layout, and furniture. Patrons favored spaces that stimulated multiple senses, such as touch, sound, smell, and sight. Additionally, they preferred interiors that reflected local culture and climate, maintained historical authenticity, and included natural tactile materials. The findings emphasize that cafe interiors designed with a “phenomenological approach,” which engages multiple senses, create stronger emotional connections and leave lasting impressions (Bilgiç & Şahin, 2021, p. 774).

2.3 Multisensory Design

2.3.1 Defining Multisensory Design

Humans are dominant in thinking and visual imaging (Spence, 2020). In *The Eyes of the Skin: Architecture and the Senses*, Pallasmaa (1996) similarly stated that

architects design mainly for the eye of the beholder. Many architects and designers have emphasized the domination of the visual sense and the inevitable production exclusively concerning the sense of vision (Corbusier, 1991; Mau, 2018). This visual dominance is explained neuroscientifically (Hutmacher, 2019). Most of our brains are occupied with the processing of visual information compared to the information acquired from the other senses (Gallace et al., 2012). Moreover, Heilig (1992), the inventor of the first “multisensory virtual reality apparatus,” provided a hierarchy of senses concerning the ranking of attentional capture (Spence, 2020, p. 2). According to this ranking, seen in **Figure 2**, vision is 70%, audition is 20%, olfaction is 5%, touch is 4%, and taste is 1% (Heilig, 1992). The prevalence of visual hegemony does not deem it to be unquestionable (Spence, 2020). Pallasmaa (1996) has stated that neglecting the senses of touch, smell, taste, and sound fails to engage and enrich the human experience fully. Furthermore, he has noted that spaces are encountered as multisensory experiences rather than mere visual images (Pallasmaa, 1996). Human experience and engagement with the world involve continuous multisensory stimulation (Shams & Seitz, 2008).

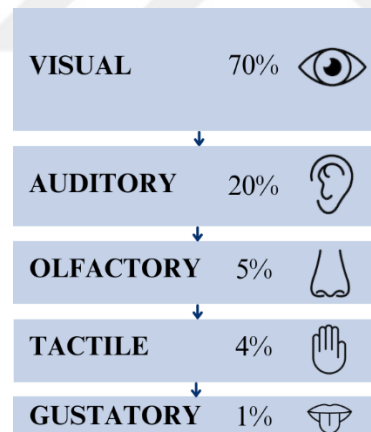


Figure 2. Heilig’s Hierarchy of Senses based on Attentional Capture (1992)

Multisensory design engages, integrates, and designs for two or more senses, going beyond a single sensory modality (Bacci & Pavani, 2014; Haverkamp, 2012). It involves visual elements and auditory, olfactory, tactile, and gustatory sensory modalities. These senses serve as communication channels where information is retrieved (Haverkamp, 2012). Multisensory interactions occur automatically and spontaneously and are compulsory mental processes (Bruno, 2022). They create enhanced cognitive stimulation and intense sensations by activating complex neural

functions (Malhotra & Abrol, 2024). Human perception involves the constant, rapid, unconscious, emotional, and automatic utilization of multiple senses to interpret the surroundings, serving as the basis for decision-making and reasoning in daily situations (Bruno, 2022; Haverkamp, 2012; Kahneman, 2011). Furthermore, the multisensory approach is multimodal and cross-modal (Spence et al., 2009). Multimodal phenomena concern the combination of multiple sensory modalities and their impact on perception. The cross-modal phenomena concern one sensory modality's impact on another's operations. Accordingly, studies reveal that senses strongly impact each other (Spence et al., 2009).

2.3.2 Multisensory Design in Public Spaces

Regarding design practice, 'multisensory' refers to providing sensory richness to environments, products, services, and media to create immersive and inclusive designs (Lupton & Lipps, 2018). Specifically, the built environment provides individuals with sensory modalities that impact user perception (Malhotra & Abrol, 2024). For instance, the Gestalt Theory is an important perspective on how the brain organizes into meaningful wholes by principles such as similarity, continuity, proximity, and closure (Wertheimer, 1938). It has been suggested that neglecting multisensory simulation yields negative health consequences, such as increases in sick-building syndrome (SBS), seasonal affective disorder (SAD), and noise pollution (Spence, 2020). The incorporation of multisensory experiences occurs in a variety of different built environments. Such environments include educational institutions, museums, hospitals, and restaurants.

Along these lines, Altay (2021) conducted a study where students recorded their experiences through reflective essays, noting sensory encounters, emotional responses, and the physical setup of their chosen public spaces. The public interior included cafes, bookstores, and retail spaces. The collected data was then analyzed thematically under eight concepts or categories: sights, sounds, smells, temperature, the temporality of experience, and total experience. As a result, Altay (2021) found that public spaces' sensory interactions and spatial orientations significantly impact users' comfort. In addition, the experiences of public spaces proved to be dynamic and influenced by changing stimuli (Altay, 2021).

Moreover, multisensory approaches are sought in educational institutions. For instance, a multisensory learning experience is an educational approach that aims to engage numerous senses simultaneously, significantly impacting memory recall and retention. Multisensory learning enables students to have a reciprocal relationship between thinking and sensory input, engaging the minds more intensely (Baines, 2008). Research in educational psychology has shown that incorporating visual, auditory, and tactile stimuli leads to encoding LTM (Korkmaz & Karatepe, 2018). Such a learning approach strengthens the learners' memory and motivations, combining the physical learning environment with interaction (Spence & Endler, 2013). Accordingly, Maliki and Yasin (2017) state that multisensory learning environments facilitate robust knowledge acquisition by enhancing cognitive abilities such as memory. Most previous literature implements multisensory techniques on students with disabilities, such as autism and dyslexia. For instance, a study conducted by Habbak and Khodeir (2023) puts forth multisensory interactive classroom environments to enhance the learning skills of children with autism, leading to the development of their skills. Multisensory learning accommodates a variety of age groups, ranging from infants to older adults. Incorporating multiple senses into the learning experience positively enhances learning regarding memory formation, thinking capacities, and interaction by simultaneously activating different brain parts (Parra, 2021).

Like educational institutions, museums utilize multisensory experiences and learning to help reinforce memory and engagement (Lillard, 2008). The idea of sensory museology was coined by Howes (2014), who initiated sensory-rich experiences in museums by incorporating sound, smell, and touch (Fors, 2013; Zhou et al., 2023). Multisensory experiences in museums create physical, social, intellectual, and emotional remarks through the engagement of the body and the mind. Moreover, it enhances learning about works of art and increases creativity and participation. For instance, the Museum of Modern Art (MoMA) utilizes multisensory experiences to appeal to audiences of different ages, interests, cultures, abilities, and learning styles (McGee & Rosenberg, 2014). According to a study conducted by Caulton (1998), visitors enjoy interactive and sensory exhibits more than traditional exhibits.

Furthermore, when designed efficiently, therapeutic spaces can activate the senses to support the regeneration and healing of the body. This approach is named multisensory therapy, which offers clients specially designed rooms with visual, auditory, tactile, and olfactory stimuli (Baker et al., 2001). These spaces include stimulating music, aromas, a variety of lights, and tactile objects (Chan et al., 2005). A study conducted by Chan et al. (2005) investigated the impact of such multisensory therapy on individuals with developmental disabilities in a hospital. In this study, the participants were divided into control and experimental groups, where the experimental group was exposed to a multisensory interior with all the senses present. They were also given pre- and post-tests. The outcomes were measured through behavioral and emotional analysis of the clients. As a result, the multisensory environment promoted long-term positive emotions, relaxation, and increased engagement (Chan et al., 2005). A similar study by Martin et al. (1998) on individuals with severe learning disabilities had a corresponding outcome. Accordingly, critical points of multisensory healthcare settings, such as color, light, material, acoustics, air quality, and natural elements, can holistically create a supportive environment that promotes well-being (Malhotra & Abrol, 2024).

Lastly, multisensoriality is gaining increased attention from chefs as an expectation from diners (Spence & Youssef, 2022). Multisensory experiences in gastronomy emphasize the stimulation of all the senses in a diner and how the senses impact each other and lead to creating engaging, memorable experiences (Yemsi-Paillissé, 2024). Multisensory restaurants utilize technological enhancements to broadcast sounds, images, and scents alongside their culinary experiences. This attempt promotes an experience beyond the virtual, intellectual, and mental journey (Yemsi-Paillissé, 2019). For instance, as analyzed by Yemsi-Paillissé (2019), Ultraviolet Restaurants by Paul Pairet in China creates an immersive interior setting for the customers. The experience involves sounds of waves, images of the ocean, and the smell of iodine and marine life alongside seafood (Yemsi-Paillissé, 2019). Such a unified experience with the senses is stated to be more memorable in comparison to the exposure of each sense individually (Pawaskar & Goel, 2014; Yemsi-Paillissé, 2019).

2.4 Memory Retention

Defining the memory systems has been valuable in shaping the neural and cognitive models of memory (Brady et al., 2011). According to Tulving (2000), memory is defined as the “neurocognitive capacity to encode, store, and retrieve information,” further suggesting that there are distinct memory systems (p.36). As previously mentioned in the multi-store memory model, there exist three memory stores: SM, STM, and LTM (Atkinson & Shiffrin, 1968). SM retains sensory information for a short duration, which gets processed by STM (Schacter & Tulving, 1994). Based on several studies, Postle (2006) has stated that the brain areas concerned with sensory perception are also responsible for the short-term storage of retrieved sensory information. The main difference between STM and LTM is their duration and capacity (Cowan, 2008), where STM has a limited capacity, and LTM can store thousands of items (Schacter & Tulving, 1994). STM typically lasts around 15 to 30 seconds without rehearsal but can be maintained longer through active maintenance, sustained attention, or rehearsal (Baddeley et al., 2015; Courtney, 2010; Cowan, 2008). For instance, Tsien (2012) has stated that “short-term memory has a time course on the order of seconds to hours, whereas LTM has a time course of weeks, months, or years (p. 965).”

LTM comprises two parts: semantic memory and autobiographical memory. General knowledge is retrieved from semantic memory. Specific episodes of our lives are stored in autobiographical memory (Verbeek & van Campen, 2013). For instance, autobiographical memories of a place can be personal experiences or past events remembered in association with a specific place. Compared to semantic memory, autobiographical memory facilitates attachment rather than solely recognizing a place from general knowledge (Knez, 2014). Successively, autobiographical memory constitutes explicit and implicit memory. Explicit memory consists of information from past events that is both conscious and factual. Implicit memory, on the other hand, consists of memories of feelings and gestures. Memories, consisting of numerous layers of meaning, are a critical mechanism for retaining and retrieving personal experiences while contributing to emotional regulation (Mills & D’Mello, 2014). Accordingly, implicit memory is divided into emotional and motor (Verbeek & van Campen, 2013). Emotional memory includes moods, feelings, and emotions,

whereas motor memory includes actions. These two memories are responsible for constituting the general field of the memory of the senses. Moreover, the sensory stimuli activate the autobiographical, implicit, emotional, and motor memories (Verbeek & van Campen, 2013). **Figure 3** delineates the process by which stimuli travel through the memory stores.

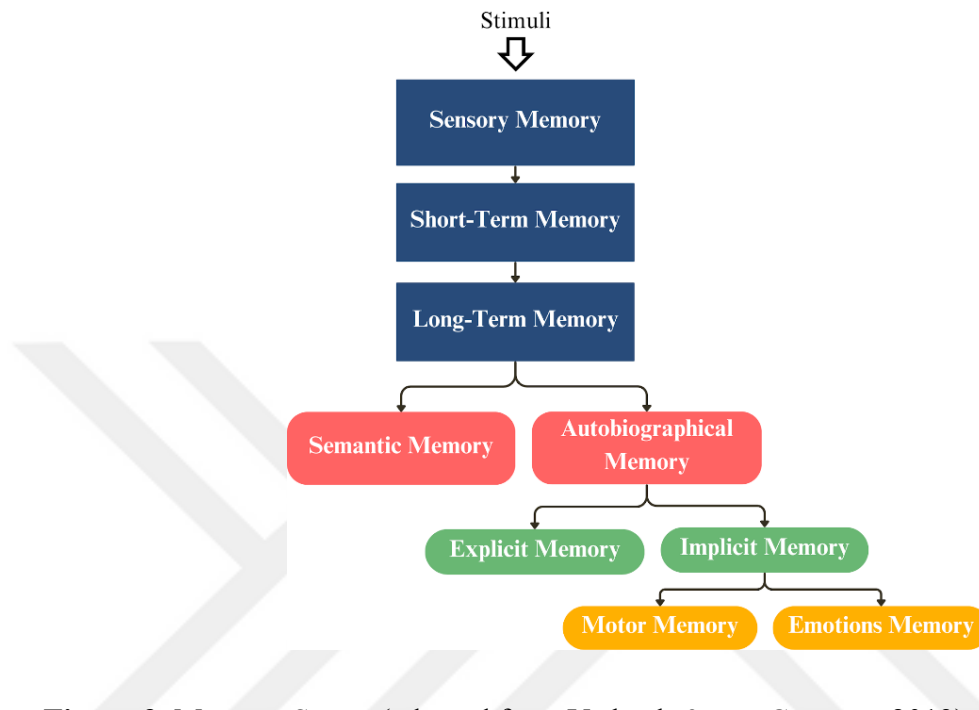


Figure 3. Memory Stores (adapted from Verbeek & van Campen, 2013)

STM is usually studied using delayed recognition tasks (Courtney, 2010). Accordingly, a study by Miller and Miller (1976) investigated the relationship between exposure duration and the information on memory retention in terms of STM. Within the study, undergraduate students were exposed to alphanumeric characters, words, and images through a screen for different periods in varying numbers of items. After the presentation, the participants were asked to recall or identify the items that were remembered. As the exposure duration increased, retention significantly improved up to a certain point. Short exposure durations were sufficient for smaller sets of information. Larger sets required longer exposure times, which improved retention. The study confirmed that exposure duration and the amount of information given are crucial factors influencing STM retention (Miller and Miller, 1976).

2.5 Role of Senses in Memory

The human brain processes information through certain sensory channels, such as visual, auditory, tactile, olfactory, and gustatory senses. Each of these senses plays an evident role in the formation and retrieval of memory. Moreover, they contribute to the richness and complexity of the stored information depending on the cognitive process (Shams & Seitz, 2008). Memory functions better when experiencing multiple sensory modalities than when experiencing single sensory modalities (Meyerhoff & Huff, 2016; von Kriegstein & Giraud, 2006). This finding is due to the activation of multisensory areas in the brain when information from different sensory modalities is experienced (Woods & Newell, 2004). Due to the additional encoding in the multisensory areas, the multimodal stimulus leads to stronger memory traces (Shams & Seitz, 2008). Even the earliest studies, such as the Montessori schools, have embraced multisensory techniques to help reinforce memory (Lillard, 2008). Montessori schools adopted visual, auditory, tactile, and along with kinesthetic approaches a century ago (Montessori, 1912). Thelen et al. (2015) further stated that stronger memories will result from the integrative process of congruent multisensory modalities, activating LTM. Sensory engagement notably impacts perception, emotion, and memory, leading to a growing interest in the field (Krishna, 2010).

Pallasmaa (2011) emphasizes that a true architectural experience requires the interaction of all senses. Memory is enhanced when these multiple senses are engaged simultaneously, allowing for richer and more robust memory traces and a strengthened connection with reality (Pallasmaa, 2011). Shams and Seitz (2008) suggest that combining information from different sensory modalities improves memory retention through the encoding and retrieval pathways. According to Thelen et al. (2015), information received through visual and auditory channels allows for better recall of information than unisensory modalities.

2.5.1 Vision and Memory

Vision serves as the dominant sense concerning spatial perception since it facilitates the initial perception of a place and helps the formation of mental images (Gibson,

1986; Globa et al., 2022). Visual stimuli can enhance memory retention by providing concrete representations of abstract concepts. On the other hand, visual memory refers to the ability to recall information presented visually. According to the research conducted by Brady et al. (2011), visual memory has a high capacity to store detailed information, significantly aiding recall. Compared to other types of memory, visual memory is more durable and allows individuals to store and retrieve detailed and vivid images of past experiences (Brady et al., 2011).

A study conducted by Li and Kim (2024) investigates the impact of multisensory stimuli in remote office environments using VR simulation. The study specifically utilized visual and olfactory stimuli, individually and simultaneously. The visual stimuli were based on lighting, and the olfactory stimuli were based on peppermint aroma through a scent card. Under the exposure to one of the three sensory conditions, the participants completed attention and memory tasks. The task performance was assessed through auditory cognitive tests: reaction time and backward digit span tests. The Backward Digit Span Test showed that the visual stimuli lighting alone significantly improved memory recall (Li & Kim, 2024).

2.5.2 Sound and Memory

Furthermore, auditory cues enrich multisensory experiences by triggering powerful emotional responses and memories due to the close link between sound and the brain's emotional processing (Zimmermann et al., 2016). Auditory cues include spoken words, environmental sounds, music, and other ambient sounds. Ambient sounds contribute to a holistic perception of space, evoking memories (Gutfreund & King, 2012). Hearing enables a strong connection with the environment in a way that sight cannot, helping form attachment (Pallasmaa, 2011). Studies have found that auditory information is retained through repetition and elaboration, reinforcing verbal content (Baddeley, 2012).

Moreover, auditory memory refers to the ability to remember the heard information. The ability to recall such auditory information accurately serves as an essential notion for learning and other tasks (Alwashmi et al., 2024). For instance, Thelen et

al. (2015) further argued that the congruency of different modalities yields stronger memories, such as an image of a dog accompanied by a barking sound.

In addition, different levels of ambient noise can impact cognitive performance (Mehta et al., 2012). For instance, moderate levels of ambient noise, about 70 decibels, lead to moderate distraction, engaging individuals in higher-level thinking. Low noise levels (50 dB) do not challenge the cognitive process, and high noise levels (more than 85 dB) create excessive distraction, making it difficult to concentrate (Mehta et al., 2012). Consequently, workspaces like cafes feature moderate noise levels for activities requiring creative cognitive performances (Legge et al., 2014). A study conducted by Legge et al. (2014) measured the noise levels in 29 cafes, recording an average of 65.9 decibels, with a range of 57.3 decibels to 73.5 decibels.

A study conducted by Pecher and Zeelenberg (2022) investigates the impact of multisensory modalities, visual and auditory, in comparison to single-modalities presentation on memory retention. They conducted four experiments. In the first experiment, participants were shown images twice, randomly on screen, paired with congruent, incongruent, or no sounds. They were asked if each image was a first or repeated presentation. The same procedure was conducted in the second experiment, focusing only on sound repetition. These two experiments were repeated at extended intervals. The data was analyzed statistically through ANOVA and Bayesian factors. As a result, the visual cues helped improve memory for sounds (Pecher & Zeelenberg, 2022).

2.5.3 Smell and Memory

Reactions to smell tend to be both quick and emotional (Beer, 2007). The reason is that the points responsible for olfactory and gustatory functions in the brain are closer to the amygdala, or the brain's emotional center (Verbeek & van Campen, 2013). Moreover, the amygdala is close to the hippocampus, which collects information through the memory tracks (Verbeek & van Campen, 2013). According to Pallasmaa (2011), scent triggers strong memories and evokes recalling past experiences associated with specific spaces. Pallasmaa (2011) further states that

olfactory memories of spaces include the childhood home, in which specific smells lead to emotions and images, contributing to spatial memory. For instance, Lwin et al. (2021) discovered that the peppermint scent in offices significantly enhanced information recall.

A study by Madzharov et al. (2018) experimented with the impact of coffee scents on the cognitive performance of undergraduate students. The participants entered either an unscented room or a room filled with a coffee-like scent through a scent diffuser. Post-exposure, the participants completed an analytical reasoning task from the GMAT. The study resulted in improved cognitive performance and test results due to the presence of a coffee scent (Madzharov et al., 2018).

Moreover, a study by Yildirim et al. (2024) emphasizes the role of olfactory stimuli in enhancing the benefits of multisensory office environments. The study utilized virtual reality simulations where participants were exposed to a non-biophilic office environment and a multisensory biophilic environment with visual, auditory, and olfactory stimuli. The participants were given both pre-tests and post-tests. A baseline cognitive test, mood assessment, and physiological measurements were taken in the pre-test. After exposure to the scenarios for six minutes each, participants completed another round of cognitive tests, mood evaluations, and physiological measurements as a post-test (Yildirim et al., 2024). The cognitive tests included a backward digit span and Stroop test, a psychological test for assessing cognitive abilities using incongruent stimuli (Liu et al., 2025; Yildirim et al., 2024). As a result of qualitative and quantitative data, the olfactory cue had a significant positive impact on the participants' experience, mood, and cognitive functions (Yildirim et al., 2024).

According to the findings outlined in the literature review, this study advances the understanding of multisensory experience through an experimental approach. The following chapter describes the research methodology employed to empirically investigate the impact of multisensory experiences on memory retention in cafe settings. It systematically lays out the details of the literature search, conceptual framework, setting, participants, procedure, instruments, and data analysis.

CHAPTER III

METHODOLOGY

3.1 Literature Search

The literature search for this research article involved an in-depth search of online databases. The search was conducted from February 2024 to April 2025. The primary aim of the search was to utilize reliable sources. The search string involved specific keywords and knowledge domains on which this study is based. The main keywords were multisensory experiences, memory, and public spaces. Specific keywords were plugged into the search string adjacent to the keyword with which a relationship was desired to be established.

Furthermore, establishing knowledge domains enabled a more systematic literature search, leading to a more specialized study of various disciplines. The research comprised three major knowledge domains: architecture, neurosciences, and psychology. The knowledge domains were further divided into keywords to define the range of inclusivity from a more focused perspective, which can be found in **Table 1**. Search engines such as Science Direct, Scopus, Web of Science, and Google Scholar were utilized. If the found source was unsuitable for the framework, it was omitted, and the literature search was continued.

Table 1. Domains and Keywords

Domains	Keywords
Architecture	Multisensory Design
	Multisensory Public Spaces
Neurosciences	Memory Retention
	Short-Term Memory
	Sensory Processing
Psychology	Memory and Senses
	Perception and Experience

3.2 Conceptual Framework

This study utilizes a mixed-method approach, incorporating both quantitative and qualitative data to comprehensively understand the impact of multisensory experiences in public spaces on memory retention among adults. This study's framework includes one independent variable and one dependent variable. The independent variable is the multisensory experience, including visual, auditory, and olfactory senses. The dependent variable is memory retention. The research includes an experimental design with multiple phases, such as baseline testing and memory recall tasks. The conceptual framework of the study can be visualized in **Figure 4**. Accordingly, multisensory experiences, visual, audio, and olfactory, will yield memory retention.

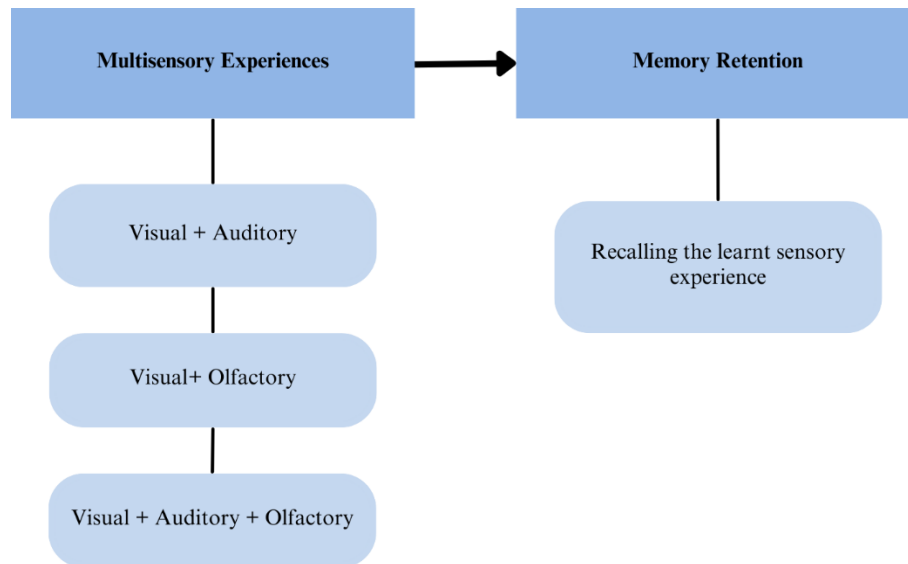


Figure 4. Conceptual Framework of the Study

3.3 Participants

The participants in this study were adults (18-65 years) residing in Ankara, Türkiye. A heterogeneous sample was aimed to possess a wide range of experience and background through convenience sampling. Participants were recruited through announcements on social media and referrals from others. The participants signed up through a digital timetable and then visited the preferred study location. The research was approved by the Bilkent University Human Ethics Committee on March 12, 2025 (No. İAEK_2025_03_12_02) (see **Appendix A**).

Before starting the experiment, all subjects were given brief information about the study and its procedures. They were then asked to sign the informed consent forms, which clearly stated that they could withdraw at any point in time from the study. The consent forms were provided either in Turkish or English, according to the choice of the participants. Both forms can be seen in **Appendix B**.

The inclusion criteria for the participants were: (a) communicative and healthy; (b) normal or corrected-to-normal vision; (c) normal motor function. The exclusion criteria of the participants for the entire experiment were those who (a) have auditory, olfactory, or cognitive impairments or problems; (b) have taken alcoholic beverages before the experiment; (c) take drugs or substances influencing the

nervous system; (d) have a Body Mass Index (BMI) higher than 30, which is indicative of obesity with higher risks of psychological disorders and cognitive impairments. The exclusion criteria of the participants for the sensory groups with olfactory experiences were those who (a) consume more than three cups of coffee in a week. The exclusion and inclusion criteria can be found in **Table 2**. According to the G-power calculations for a one-way ANOVA, this research requires a sample size of approximately 76 subjects for an effect size of 0.4 at the 0.05 alpha level. The G-power calculations can be found in **Appendix C**.

Table 2. Inclusion and Exclusion Criteria

Inclusion Criteria	Exclusion Criteria
(a) communicative and healthy	(a) have auditory, olfactory, or cognitive impairments or problems
(b) normal or corrected-to-normal vision	(b) have taken alcoholic beverages before the experiment
(c) normal motor function	(c) take drugs or substances influencing the nervous system
	(d) have a Body Mass Index (BMI) higher than 30
	(e) consume more than three cups of coffee in a week*

* excluded from the sensory groups with olfactory experiences

Accordingly, a total of 83 participants were initially recruited for the study. However, four participants among the 83 were excluded based on the exclusion criteria. The remaining 79 participants were assigned randomly into four groups, considering the exclusion criteria for the olfactory experience. After the experiment, three additional participants were removed due to unsatisfactory scores on vision and auditory tests. In total, the outcomes of 76 participants were valid and met the criteria. **Table 3** depicts the demographic distribution of these 76 participants.

Table 3. Demographic Division

Demographics	Values	Frequency	Percentage (%)
Gender	Male	40	52.6
	Female	36	47.4
Age	18-24	14	18.4
	25-34	27	35.5
	35-44	21	27.6
	45-54	11	14.5
	55-65	3	4
Marital Status	Single	48	63.1
	Married	24	31.6
	Divorced	4	5.3
Education	Highschool	20	26.3
	Undergraduate	46	60.5
	Master	9	11.9
	Doctor	1	1.3
Nationality	Türkiye	67	88.2
	Other	9	11.8
Sensory Group	Visual	19	25
	Visual + Auditory	19	25
	Visual + Olfactory	19	25
	Visual + Auditory + Olfactory	19	25

Number of Participants = 76

3.4 Experimental Setting

The study was conducted in an indoor controlled environment in Ankara, Türkiye. There were two home office environments in total seen in **Figure 5**. The settings consistently involved a computer screen for visual cues, speakers/headphones for

auditory cues, a bottle of coffee for olfactory cues, a table, a chair, a Wi-Fi connection, and an electrical circuit to make the experiment design possible. The settings provided a controlled environment to observe the impact of multisensory experiences on memory retention under basic and moderate indoor conditions. The settings ensured minimal distraction and sensory overload for a conducive environment in terms of data collection. The room conditions were consistent throughout the experiment for all the participants.



Figure 5. Experimental Settings

3.5 Procedure

The experimental design was conducted from February to April 2025. It consists of six stages. In the first stage, the participants were recruited through convenience sampling. They were informed about the study and its potential risks and benefits through an informed consent form. Then, they were expected to fill out a demographic questionnaire. The participants underwent two baseline examinations, the first being the Mindful Attention Awareness Scale (MAAS) (Brown & Ryan, 2003) and the second the Montreal Cognitive Assessment (MoCA) (Nasreddine et al., 2005). According to the exclusion criteria, the participants were randomly and equally divided into four groups: one unisensory and three multisensory experiences.

The unisensory group was visual, where the participant was only exposed to an image of a cafe space. The multisensory groups were visual and auditory, visual and olfactory, and visual, auditory, and olfactory. In the visual and auditory experience, the participants were exposed to one image of a cafe space and an auditory cue. In the visual and olfactory experience, the participants were exposed to one image of a cafe space and an olfactory cue. In the visual, auditory, and olfactory experience, the participants were exposed to one image of a cafe space and auditory and olfactory cues. Throughout the four experiences, one consistent image of a cafe space was utilized. The author designed and produced the cafe image using Sketchup 2024 and Enscape 4.2.1.88. All participants were exposed to the sensory material for two minutes in total. Then, the participants were given a distraction task of solving a 42-piece puzzle, which they had to solve for two minutes.

Finally, the retention of the learned image was assessed by the open-ended task of 'Describe the space in detail.' The participants recorded their responses on paper for as long as they felt was sufficient. The participants were given an auditory and visual test at the end to keep their attention sustained for the main parts of the experiment. Participants who did not meet the baseline for these tests were eliminated. Lastly, the data gathered from the experiment was analyzed qualitatively and quantitatively. The retrieved data was categorized through a matrix and was qualitatively analyzed by content analysis. The quantitative analysis of the data retrieved was carried out using three different statistical tests: one-way ANOVA, *Pearson's* correlation, and an independent T-test. The statistical analysis software JASP 0.18.3.0 was utilized for this phase. The phases can be visually followed in **Figure 6**. Moreover, the procedure for each participant can be analyzed in detail in **Figure 7**.

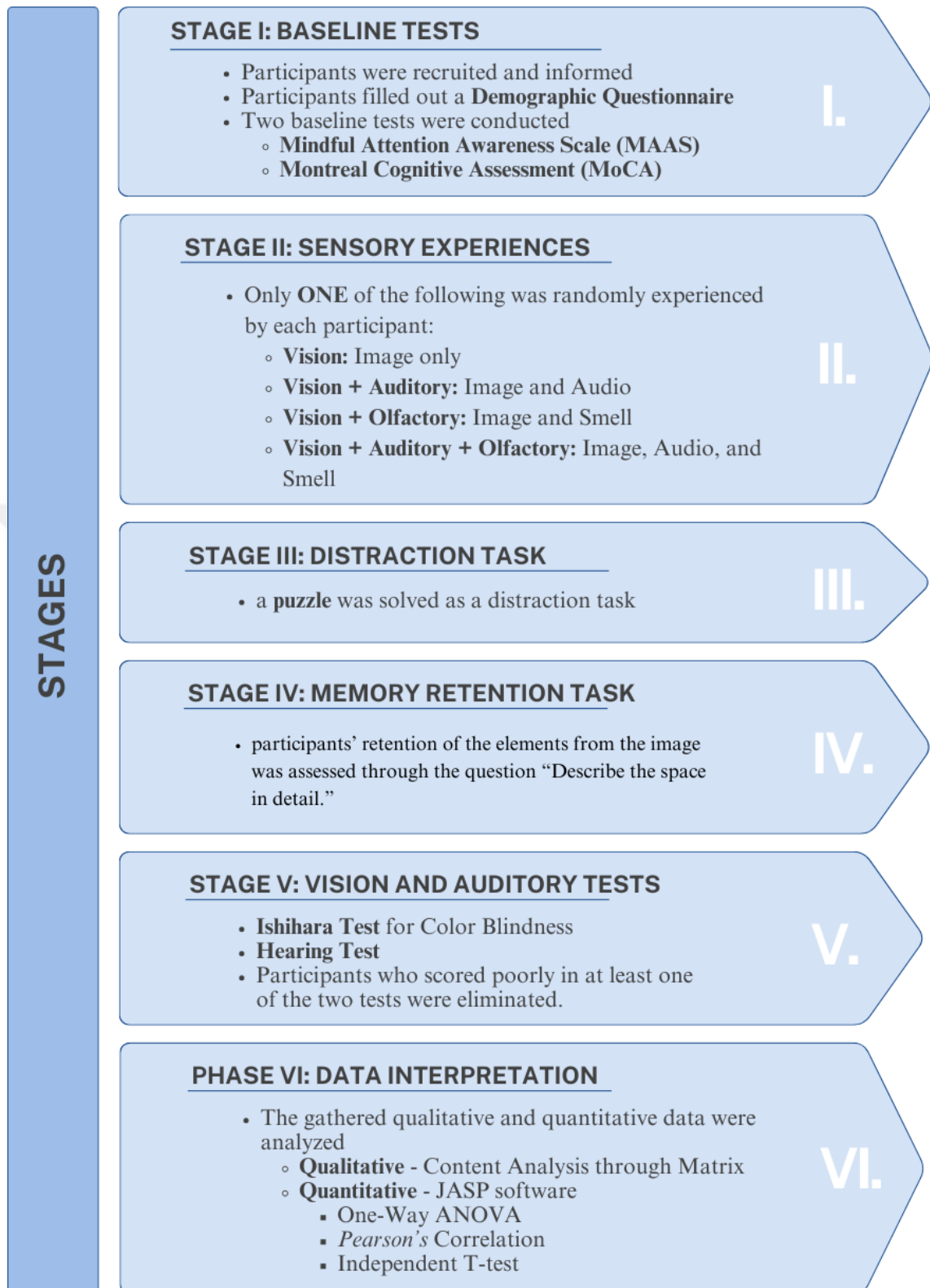


Figure 6. Phases of the Study

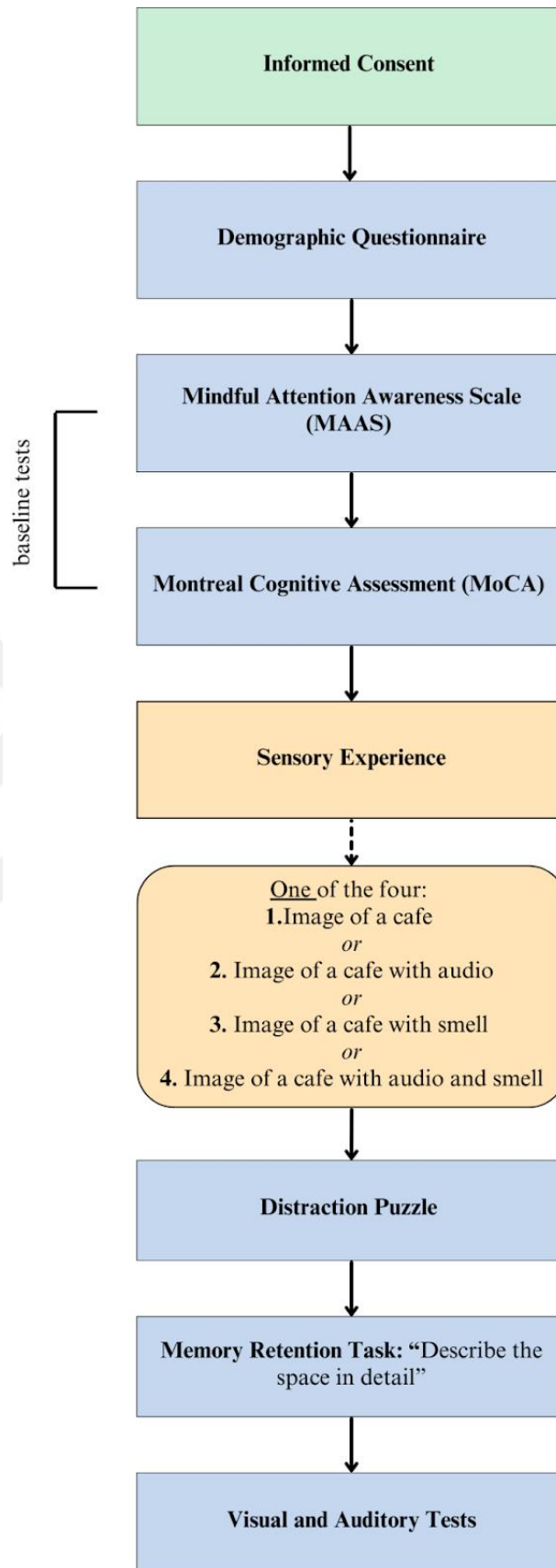


Figure 7. Procedure For Each Participant

3.6 Instruments

The study was conducted through both objective and subjective measures. The subjective measurement consists of the first baseline test, MAAS, and the memory retention task. The objective assessment includes the MoCa test (the second baseline test), a demographic questionnaire, the Ishihara test, and the auditory test. **Figure 8** visualizes the phases with their corresponding instruments.

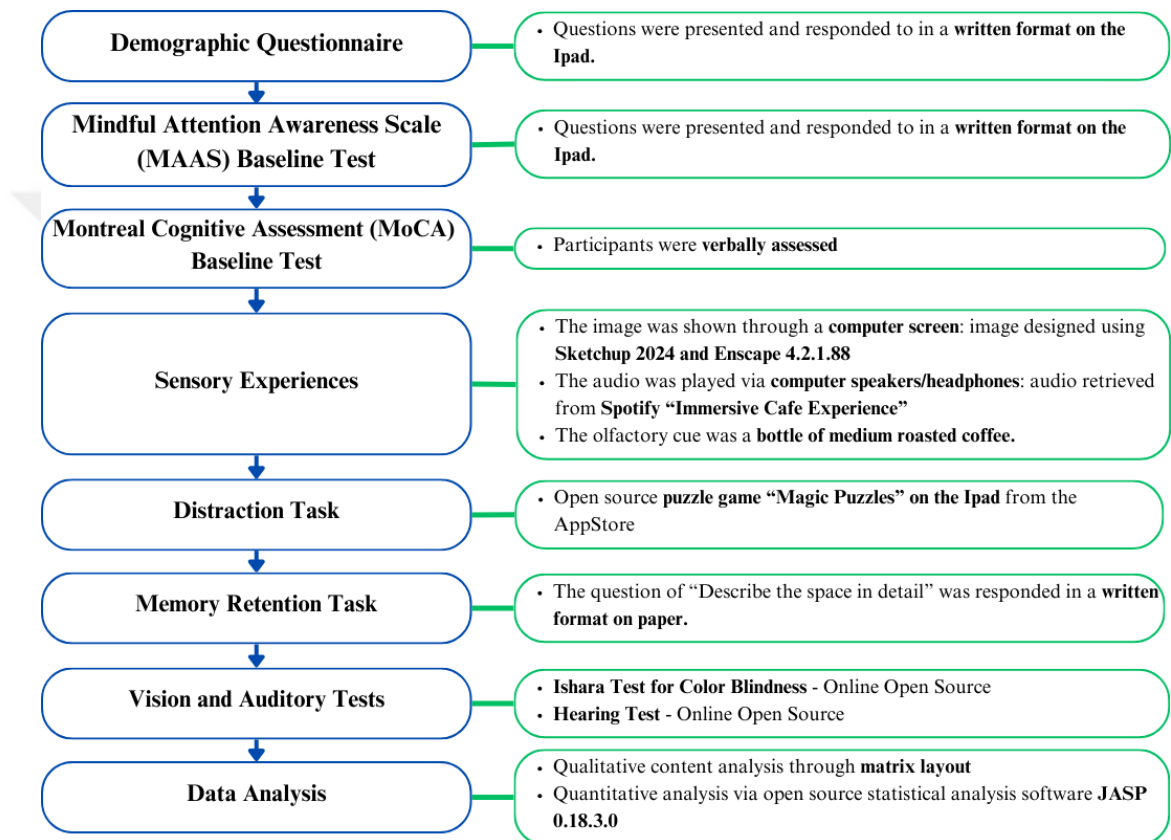


Figure 8. Phases and Corresponding Instruments

3.6.1 Demographic Questionnaire

The demographic questionnaire consists of 15 questions concerning factual information about the participants (see **Appendix D**). The first part of the demographic questionnaire gathers preliminary information about the participants, such as gender, age, and education level. The second part questions whether or not the participants have any known and corrected visual, auditory, olfactory, or cognitive impairments. In addition, it asks if the participants have a body mass index

(BMI) higher than 30. The third and final part of the questionnaire determines participants' eligibility for the experiment and guides the randomization of the sensory groups. It includes questions about their consumption of coffee, tobacco, alcohol, or drugs in the past 24 hours.

3.6.2 Mindful Attention Awareness Scale (MAAS)

The first baseline test, the MAAS, was adapted from existing literature (Brown & Ryan, 2003). MAAS is a 15-item scale that assesses the mindfulness, attention, and sensitive awareness of individuals. It uses a 6-point Likert scale where the participants respond to statements regarding their everyday experiences (Brown & Ryan, 2003; Carlson & Brown, 2005). The participants responded to this test on the iPad with a digital pencil. The results of MAAS were evaluated through the mean of the responses to the 15 items; a higher mean yields higher attention and mindfulness. Both the English and Turkish versions of the scale can be found in **Appendix E** (Brown & Ryan, 2003; Carlson & Brown, 2005; Catak, 2012).

3.6.3 Montreal Cognitive Assessment (MoCA)

The second baseline test, the MoCA, was also adapted from existing literature. This study utilized the original version of the MoCA test, version 7.1 (Nasreddine et al., 2005). In alignment with the research objectives, only the memory, attention, and delayed recall sections were evaluated. MoCA is a validated test for the detection of cognitive impairments and the accurate assessment of STM, working memory, concentration, and attention (Nasreddine et al., 2005). The MoCA test was verbally conducted and responded to by the participants. The responses were recorded digitally by the researcher. The memory and delay recall sections are out of five points, and the attention section is out of six points, making it out of eleven in total. The baseline test was conducted in Turkish or English; the copy and translation can be found in **Appendix F**.

3.6.4 Sensory Experiences

A variety of instruments were used in the four different groups of sensory experiences. The visual of the cafe was shown to all the groups through a digital screen. The cafe image was designed by the author via Sketchup 2024 and Enscape version 4.2.1.88. The final cafe design was achieved through the consultation of three interior architects on their perspectives regarding ‘typical contemporary cafe environments.’ The interior architects were chosen based on their experience in the field. Each interior architect was consulted individually across three stages. In the first stage, they were asked to describe key characteristics they associate with contemporary cafe environments. In the second stage, they reviewed the preliminary design draft and provided feedback on the design elements. In the final stage, they evaluated the revised design to ensure it met their professional expectations for a typical contemporary cafe. These stages were completed within three weeks. The results can be seen in **Figure 9**.



Figure 9. Visual Stimulus

An auditory stimulus was played through the speakers at an average of 67 dB, which is the average noise level of cafe environments (Legge et al., 2014). The auditory stimulus was a sound from Spotify named ‘Immersive Cafe Experience.’ To reach the appropriate decibel, an open-source app from the App Store was used to measure the

sound level. The olfactory stimulus was a bottle of medium-roasted coffee set in front of the participant for them to inhale (Hawiset, 2019). Specifically, coffee has many reported benefits, such as reducing stress and altering memory, mood, blood pressure, and other physiological and psychological factors (Hawiset, 2019). The coffee was purchased from a local supermarket. The coffee was specifically chosen as medium-level roasted coffee (roasted at 205-220°C) due to its intense scent, natural flavor, and popularity among coffee drinkers. The coffee powder was placed inside a glass bottle for the participants to inhale (Hawiset, 2019).

3.6.5 Distraction and Memory Retention Tasks

After the sensory experience phase, each participant had to solve a 42-piece puzzle on the iPad for two minutes as a distraction. The puzzle was kept consistent for all the participants and was retrieved from an open-source app available on the App Store, as shown in **Figure 10**. A timer was used to time the participants in the sensory and distraction phases. Lastly, the participants completed an open-ended memory retention task on paper using a pen. The memory retention task required a detailed description of the previously shown cafe image.



Figure 10. Distraction Task from an Open-Source Puzzle App

3.7 Data Analysis

The collected quantitative data is analyzed using an open statistical analysis source, JASP 0.18.3 version (JASP Team, 2024). Three different statistical tests were conducted for the different hypotheses: one-way ANOVA, *Pearson's* correlation, and individual T-test.

The qualitative data collected was analyzed using a manual content analysis. A matrix table was created with eight distinct concepts based on the responses provided in the open-ended memory retention task. The eight concepts, organized into columns, are: colors, furniture, fixtures, materials, spatial remarks, accessories, numerical values, and sensory stimuli. Out of the 76 participants, 67 preferred the experiment to be conducted in Turkish, while the remaining nine chose English. Each written response was carefully analyzed and categorized according to its relevant concept. The Turkish responses were translated into English, and the coding was executed in English. Additionally, specific keywords were assigned to the listed items. For example, if a participant mentioned 'tall chairs,' it was coded as 'bar stools.' Therefore, whenever other participants referred to 'tall chairs' or 'bar chairs' or anything along those lines, these terms would also be coded as 'bar stools.' Consistent keywords were used for every unique item throughout the matrix. All unique items mentioned by the participants were documented in a separate table (see **Appendix G: Figure 7e**). The results of the content analysis were quantitatively presented, showing the total number of items listed by each participant, both overall and by category. The layout of this data can be found in **Table 4**.

Table 4. Qualitative Matrix Table Layout

Group #	Colors	Furniture	Fixtures	Materials	Spatial Remarks	Accessories	Numerical Values	Sensory Stimuli	Total
Visual	1								
Visual + Auditory	2								
Visual + Olfactory	3								
Visual + Auditory + Olfactory	4								

The methodology chapter has established the detailed procedures undertaken for the data collection and analysis process. The following chapter presents the results retrieved from both the quantitative and qualitative data, offering insights gathered through the experimental setting. The statistical and content analyses reveal patterns and relationships in the research questions and hypotheses, which are subsequently interpreted in the discussion chapter.

CHAPTER IV

RESULTS

The results of this study examine the impact of multisensory experiences on memory through a series of statistical analyses. The responses to the demographic questionnaire, memory retention task, MAAS, and MoCA were organized in Excel tables and then replicated on the statistical test software JASP 0.18.3.0. Descriptive analysis was primarily conducted to retrieve the mean, median, range, etc., scores for each assessment and questionnaire. Multiple independent sample comparisons were conducted to assess the significance of the variances in memory retention between the four sensory groups. A one-way ANOVA, including a custom contrast, was run specifically to test whether the visual, auditory, and olfactory group significantly outperformed the other sensory groups. Following the one-way ANOVA, a post-hoc analysis was conducted to explore pairwise differences among the groups. Lastly, *Pearson's* correlation was conducted to analyze the relationship between cognitive and attentional abilities (as tested on MAAS and MoCa) and memory retention.

4.1 Analysis of Demographic Questionnaire

A total of 76 participants were evenly distributed across the four sensory groups. Accordingly, each group consisted of 19 participants in total. Across all groups, there was a nearly equal distribution of female to male participants, except the visual and auditory group, where the male representation was higher (73.7%). The age distribution showed a variety among the groups. The visual and auditory group had the highest representation of 25-34-year-olds (57.9%). Then the visual, auditory, and olfactory group had a higher proportion of participants aged 35-44 (47.4%). The visual and olfactory group had the youngest population (below the age

of 35) out of all the groups. On the contrary, the visual, auditory, and olfactory groups had the highest population (above the age of 35) of the older participants.

In terms of education level, the visual group had the highest number of participants with undergraduate degrees (94.7%). The visual and olfactory group had the highest number of participants (52.6%) with undergraduate degrees. The visual and auditory group and the visual, auditory, and olfactory group had the highest number of participants (47.4%) with undergraduate degrees. In contrast, the visual, auditory, and olfactory group had the highest percentage with graduate degrees, with 31.6%.

Additionally, the visual and olfactory group had the highest percentage of single participants (84.2 %). The visual and the visual and auditory groups both had an approximately equal number of single and married participants. The visual, auditory, and olfactory groups and the visual and olfactory groups both had the highest divorce percentage (10.5%). The demographic chart is further illustrated in **Table 5**. For the total statistics, refer back to **Table 3**.

Table 5. Comparison of Participant Demographics by Sensory Group

Sensory Groups								
<i>Attributes</i>	Visual		Visual + Auditory		Visual + Olfactory		Visual + Auditory + Olfactory	
	n = 19	%	n = 19	%	n = 19	%	n = 19	%
Gender								
Male	8	42.1	14	73.7	9	47.4	9	47.4
Female	11	57.9	5	26.3	10	52.6	10	52.6
Age								
18-24	4	21.1	3	15.8	6	31.6	1	5.3
25-34	6	31.6	11	57.9	7	36.8	3	15.8
35-44	7	36.8	3	15.8	2	10.5	9	47.4
45-54	1	5.3	1	5.3	4	21.1	5	26.3

<i>Age</i>								
55-65	1	5.3	1	5.3	-	-	1	5.3
<i>Education</i>								
Highschool	1	5.3	8	42.1	7	36.8	4	21.1
Undergraduate	18	94.7	9	47.4	10	52.6	9	47.4
Master	-	-	1	5.3	2	10.5	6	31.6
Doctor	-	-	1	5.3	-	-	-	-
<i>Marital Status</i>								
Single	11	57.9	10	52.6	16	84.2	11	57.9
Married	8	42.1	9	47.4	1	5.3	6	31.6
Divorced	-	-	-	-	2	10.5	2	10.5

Number of Participants =76

4.2 Analysis of Memory Retention Scores Across Sensory Experiences

The response of each participant was coded onto a matrix layout through content analysis. The coded items across the eight concepts- colors, furniture, fixtures, materials, spatial remarks, accessories, numerical values, and sensory stimuli- were added to the total memory retention score. In total, the participants replied with 137 distinct items. The content analysis table with the coded responses from participants and their scores can be seen in **Appendix G**.

The memory retention scores calculated through the content analysis table were then entered into JASP for descriptive analysis. As can be seen from **Table 6**, the visual, auditory, and olfactory group has the highest mean (32.2), median (31), and mode (31), indicating higher memory retention scores as compared to the other groups. Whereas the visual group has the lowest mean (13.8), median (13), and mode (10), and therefore seems to have lower memory retention scores than the other groups. The visual and auditory and the visual and olfactory groups are the second and third highest means and medians. Moreover, these two groups have close means (23 and

21.9) and medians (23 and 21). The means for each group, presented in graph form, can be found in **Appendix H**.

The visual, auditory, and olfactory group has the highest standard deviation (11.9), suggesting higher variability in memory retention scores. The visual group has the smallest standard deviation (5.8), indicating consistency among the participant scores. The range score is the widest in the visual, auditory, and olfactory groups, with a minimum of 13 and a maximum of 57. This shows a wide range of memory retention scores.

Table 6. Descriptive Statistics of Memory Retention Scores among Sensory Experience Groups

	Memory Retention Scores			
	Visual	Visual + Auditory	Visual + Olfactory	Visual + Auditory + Olfactory
Valid	19	19	19	19
Missing	0	0	0	0
Mean	13.8	23	21.9	32.2
Median	13	23	21	31
Mode	10	17	14	31
Std. Deviation	5.8	5.7	7.8	11.9
Minimum	4	16	10	13
Maximum	24	35	39	57

4.3 Memory Retention Scores by Concepts Across Sensory Modalities

Moreover, **Table 7** presents the descriptive analysis for the eight content analysis concepts in the four sensory groups. The concepts are colors, furniture, fixtures, materials/forms, spatial remarks, accessories, numerical values, and sensory stimuli. Investigation of these concepts in the memory retention task finds some patterns concerning sensory groups.

Primarily, memory retention for colors increased as more sensory modalities were introduced. The visual group had the lowest recall, with a mean of 0.9, while the visual, auditory, and olfactory groups had the highest recall, with a mean of 3.3. Furniture was a concept that was consistently remembered among the sensory groups. The mean value of furniture had a slight increase from visual (4.1) to visual, auditory, and olfactory (5.6). Fixtures were at relatively low levels across all the sensory modalities, with a slight increase from visual (1.3) to visual, auditory, and olfactory (1.7), suggesting minor improvements. Memory retention was higher for materials/forms in the two groups with the olfactory stimulus. Moreover, the concept of spatial remarks showed one of the most notable improvements. The visual group had low memory retention for spatial remarks, with a mean of 1.3, which dramatically increased in the visual, auditory, and olfactory group, with a mean of 6.8. The accessories concept also showed an increase across all concepts, with a peak in the visual, auditory, and olfactory groups (7.4). Regarding numerical values, the visual group showed the lowest recall (mean = 1.5), and the visual, auditory, and olfactory groups showed the highest (mean = 5.3). Among all four groups, the concept with the lowest recall was the sensory stimuli.

Table 7. Descriptive Statistics for Memory Retention Scores by Concept Across Sensory Groups

Colors				
	Visual	Visual + Auditory	Visual + Olfactory	Visual + Auditory + Olfactory
Mean	0.9	2.3	1.4	3.3
Median	0	2	1	3
Std. Deviation	1.3	2.1	1.6	2.8
Minimum	0	0	0	0
Maximum	4	8	5	10

Furniture				
	Visual	Visual + Auditory	Visual + Olfactory	Visual + Auditory + Olfactory
Mean	4.1	4.8	4.9	5.6
Median	5	5	5	6
Std. Deviation	1.7	1.7	1.5	1.2
Minimum	0	1	3	3
Maximum	7	8	8	8

Table 7. (cont'd)

Fixtures				
	Visual	Visual + Auditory	Visual + Olfactory	Visual + Auditory + Olfactory
Mean	1.3	1.6	1.3	1.7
Median	1	2	1	2
Std. Deviation	0.9	0.9	1.1	1.1
Minimum	0	0	0	0
Maximum	3	3	3	3

Materials/Forms				
	Visual	Visual + Auditory	Visual + Olfactory	Visual + Auditory + Olfactory
Mean	0.5	0.3	1.2	1.9
Median	0	0	0	1
Std. Deviation	0.7	0.6	1.9	2.1
Minimum	0	0	0	0
Maximum	2	2	6	6

Spatial Remarks				
	Visual	Visual + Auditory	Visual + Olfactory	Visual + Auditory + Olfactory
Mean	1.3	3.8	3.3	6.8
Median	1	3	3	7
Std. Deviation	1.2	2.3	2.7	3.8
Minimum	0	0	0	0
Maximum	4	9	9	13

Accessories				
	Visual	Visual + Auditory	Visual + Olfactory	Visual + Auditory + Olfactory
Mean	4.5	6.4	6.5	7.4
Median	4	7	6	7
Std. Deviation	2	2.9	2	2.5
Minimum	1	0	4	4
Maximum	8	11	10	12

Numerical Values				
	Visual	Visual + Auditory	Visual + Olfactory	Visual + Auditory + Olfactory
Mean	1.5	3.5	3.1	5.3
Median	2	4	2	5
Std. Deviation	1.6	2.5	3.7	3.4
Minimum	0	0	0	0
Maximum	6	8	13	12

Table 7. (cont'd)

	Sensory Stimuli			
	Visual	Visual + Auditory	Visual + Olfactory	Visual + Auditory + Olfactory
Mean	0	0.2	0.1	0.2
Median	0	0	0	0
Std. Deviation	0	0.5	0.3	0.6
Minimum	0	0	0	0
Maximum	0	2	1	2

4.4 Independent Sample Comparisons Between Sensory Experiences

An independent sample t-test was run among each group to compare the results of the participants of each group statistically. **Table 8** presents the independent sample t-test and descriptive results for the visual and the visual and auditory groups. $P < .001$ indicates a very strong significance between the scores of the two groups. The negative t-value (-4.9) and negative Cohen's d (-1.6) show that the visual and auditory group had significantly higher memory retention scores than the visual group. Moreover, the -1.6 Cohen's d is a large effect size, suggesting that the auditory stimulus has a strong and meaningful impact on memory retention. The confidence interval also confirms the statistical significance of the effect size.

Table 8. Independent Sample Comparison and Descriptives of the Visual and the Visual and Auditory Groups

Independent Samples T-Test						
	t	df	p	Cohen's d	SE Cohen's d	95% CI for Cohen's d
						Lower Upper
Memory Retention Score	-4.9	36	< .001	-1.6	0.4	-2.3 -0.9

Table 8. (cont'd)

Descriptives						
	Sensory Group	N	Mean	SD	SE	Coefficient of variation
Memory Retention Score	Visual	19	13.8	5.8	1.3	0.4
	Visual + Auditory	19	23	5.7	1.3	0.2

Table 9 compares the independent sample t-test and descriptive results of the memory retention scores for the visual and the visual and olfactory groups. Again, the p-value shows that the difference between the visual and the visual and olfactory groups indicates statistically strong significance. The negative t-value (-3.6) and negative Cohen's d (-1.2) indicate that the visual and olfactory groups performed better than the visual group. Cohen's d of -1.2 represents a large effect size with a significant impact. Lastly, the confidence interval supports the statistical reliability of the results.

Table 9. Independent Sample Comparison and Descriptives of the Visual and the Visual and Olfactory Groups

Independent Samples T-Test							
	t	df	p	Cohen's d	SE Cohen's d	95% CI for Cohen's d	
						Lower	Upper
Memory Retention Score	-3.6	36	<.001	-1.2	0.4	-1.9	-0.5

Descriptives						
	Sensory Group	N	Mean	SD	SE	Coefficient of variation
Memory Retention Score	Visual	19	13.8	5.8	1.3	0.4
	Visual + Olfactory	19	21.9	7.8	1.8	0.4

Table 10 compares the independent sample t-test and descriptive results of the memory retention scores for the visual and the visual, auditory, and olfactory groups. The p-value shows that the difference between the visual and the visual, auditory, and olfactory groups indicates statistically strong significance. The negative t-value

(-6.1) and Cohen's d (-2.0) indicate that the visual, auditory, and olfactory groups performed better than the visual group. Cohen's d of -2 represents a large effect size well above the 0.8 threshold for a 'large effect.' This finding suggests that additional sensory stimuli have a strong impact on memory retention scores. The confidence level confirms the statistical reliability of the effect.

Table 10. Independent Sample Comparison and Descriptives of the Visual and the Visual, Auditory, and Olfactory Groups

Independent Samples T-Test						
	t	df	p	Cohen's d	SE Cohen's d	95% CI for Cohen's d
						Lower Upper
Memory Retention Score	-6.1	36	< .001	-2	0.5	-2.8 -1.2
Descriptives						
	Sensory Group	N	Mean	SD	SE	Coefficient of variation
Memory Retention Score	Visual	19	13.8	5.8	1.3	0.4
	Visual + Olfactory + Auditory	19	32.2	11.9	2.7	0.4

Table 11 compares the independent sample t-test and descriptive results of the memory retention scores for the visual and olfactory and the visual and auditory groups. The p-value shows that there is no statistical significance between these two groups. The positive t-value (0.5) and Cohen's d (0.2) indicate that the visual and olfactory group performed slightly better than the visual and auditory group. Cohen's d of 0.2 is a small effect size, and the wide confidence interval shows that the effect cannot be claimed as real.

Table 11. Independent Sample Comparison and Descriptives of the Visual and Olfactory and the Visual and Auditory Groups

Independent Samples T-Test						
	t	df	p	Cohen's d	SE Cohen's d	95% CI for Cohen's d
						Lower Upper
Memory Retention Score	0.5	36	0.6	0.2	0.3	-0.5 0.8

Descriptives						
	Sensory Group	N	Mean	SD	SE	Coefficient of variation
Memory Retention Score	Visual + Olfactory	19	23.0	5.7	1.3	0.2
	Visual + Auditory	19	21.9	7.8	1.8	0.4

Table 12 compares the independent sample t-test and descriptive results of the memory retention scores for the visual and olfactory and the visual, olfactory, and auditory groups. The p-value is equal to 0.0031, which is below the 0.05 threshold, indicating statistical significance between the two groups. The negative t-value (-3.2) and Cohen's d (-1.0) suggest that the visual, auditory, and olfactory group had significantly higher memory retention scores than the visual and olfactory group. Cohen's d of -1.0 is a large effect size, which indicates the effect to be meaningful. Also, the confidence interval confirms the reliability of this result.

Table 12. Independent Sample Comparison and Descriptives of the Visual and Olfactory and the Visual, Auditory, and Olfactory Groups

Independent Samples T-Test

	t	df	p	Cohen's d	SE Cohen's d	95% CI for Cohen's d	
						Lower	Upper
Memory Retention Score	-3.2	36	3.1x10 ⁻³	-1	0.4	-1.7	-0.3

Descriptives

	Sensory Group	N	Mean	SD	SE	Coefficient of variation
Memory Retention Score	Visual + Olfactory	19	21.9	7.8	1.8	0.4
	Visual + Auditory + Olfactory	19	32.2	11.9	2.7	0.4

Lastly, **Table 13** compares the independent sample t-test and descriptive results of the memory retention scores for the visual and auditory, and the visual, olfactory, and auditory groups. Two types of t-tests are utilized for this group: the Student's t-test assumes equal variances, whereas Welch's t-test does not. Yet, both tests show the same direction and magnitude. Both t-tests show that the p-values are less than 0.01, indicating statistical significance. The negative t values and negative Cohen's d indicate that the visual, auditory, and olfactory groups performed well. Cohen's d of -1.0 represents a large effect size, and the confidence interval shows that the effect is strong and reliable.

Table 13. Independent Sample Comparison and Descriptives of the Visual and Auditory and the Visual, Auditory, and Olfactory Groups

Independent Samples T-Test

	Test	Statistic	df	p	Cohen's d	SE Cohen's d	95% CI for Cohen's d	
							Lower	Upper
Memory Retention Score	Student	-3.0	36	4.3x10 ⁻³	-1.0	0.4	-1.7	-0.3
	Welch	-3	26	5.2x10 ⁻³	-1	0.4	-1.7	-0.3

Descriptives

	Sensory Group	N	Mean	SD	SE	Coefficient of variation
Memory Retention Score	Visual + Auditory	19	23.0	5.7	1.3	0.2
	Visual + Auditory + Olfactory	19	32.2	11.9	2.7	0.4

4.5 Effect of Multisensory Stimulation on Memory Retention

A one-way ANOVA test was conducted among all four sensory groups to test whether there was a significant difference in memory retention. According to **Table 14**, the F-value of 16.2 indicates that the variability between group means is greater than the variability within the groups. The p-value shows statistical significance, which means that at least one group's mean memory retention score significantly differs from the others.

Table 14. One-Way ANOVA Between All Four Sensory Groups

ANOVA

Cases	Sum of Squares	df	Mean Square	F	p
Sensory Groups	3241.1	3	1080.4	16.2	< .001
Residuals	4816.1	72	66.9		

After the one-way ANOVA, a custom contrast was conducted, specifically comparing the visual, auditory, and olfactory groups against the combined average of the other three groups (visual, visual and auditory, and visual and olfactory). According to **Table 15**, the participants in the visual, auditory, and olfactory group scored 37.9 points higher in the memory retention task than the average of the other three groups. The confidence level verifies the statistical significance. Moreover, the high t-value and low p-value confirm that this difference is highly significant and is unlikely to happen by chance.

Table 15. One-Way ANOVA Custom Contrast Against the Visual, Auditory, and Olfactory Group and the Other Three Groups

Custom Contrast		95% CI for Mean Difference		SE	df	t	p
Comparison	Estimate	Lower	Upper				
visual + olfactory + auditory vs. all	37.9	25	50.9	6.5	72	5.8	<.001

A post hoc Tukey comparison was conducted to analyze the pairwise differences between all the sensory groups, building on the ANOVA results. As seen in **Table 16**, this comparison shows which specific group differences are statistically significant. All groups performed significantly better than the visual group. Moreover, the triple-sensory group (visual, auditory, and olfactory) performed significantly better than all the other sensory groups. The largest difference exists between the means of the visual and the visual, auditory, and olfactory groups (-18.4). There is no significant difference between the visual and auditory, and the visual and olfactory groups, suggesting they have similar benefits.

Table 16. Post Hoc Comparisons Among All Sensory Groups

Post Hoc Comparisons – Sensory Groups							
		Mean Difference	95% CI for Mean Difference		SE	t	ptukey
			Lower	Upper			
Visual	(Visual + Auditory)	-9.2	-16.2	-2.2	2.7	-3.5	4.8×10 ⁻³
	(Visual + Olfactory)	-8.1	-15.1	-1.1	2.7	-3.1	1.6×10 ⁻²
(Visual + Auditory)	(Visual + Auditory + Olfactory)	-18.4	-25.4	-11.4	2.7	-6.9	< .001
	(Visual + Olfactory)	1.1	-5.9	8.1	2.7	0.4	1
	(Visual + Auditory + Olfactory)	-9.2	-16.2	-2.2	2.7	-3.5	4.8×10 ⁻³
(Visual + Olfactory)	(Visual + Auditory + Olfactory)	-10.3	-17.3	-3.3	2.7	-3.9	1.3×10 ⁻³

4.6 Descriptive Analysis of the Mindful Attention Awareness Scale (MAAS)

The MAAS required the participants to rate statements regarding their daily life on a 6-point Likert scale. The higher the score, the higher the level of mindfulness and attention the participants have. **Table 17** provides the descriptive statistics of each question for all 76 participants. M1.1, M1.2, M1.4, M1.10, M1.12, and M1.15 have the highest mode of 6. This indicates that the highest point was the most frequently chosen answer by the participants. Whereas M1.3, M1.5, M1.6, M1.7, M1.8, M1.9, M1.11, and M1.14 have modes (5, 4, 3) lower than 6. M1.13 had the lowest mode 2.

Statements M1.2, M1.10, M1.12, and M1.15 show higher values for the mean (4.8 - 5.1), suggesting that participants reported a higher level of mindfulness for these questions. On the contrary, statements M1.6, M1.11, and M1.13 have lower means (3.1 - 3.8), indicating average lower mindfulness levels. According to the standard deviation, participants had more spread-out responses (S.D. = 1.5-1.6) for statements M1.4, M1.6, and M1.13 and had similar responses (S.D. = 1.1-1.2) for statements M1.10 and M1.15. Lastly, the mean of the total mean of the scores is 4.3, which

represents the average score across all questions. The minimum total score among all the participants was 2.2, and the maximum was 5.5. The standard deviation for the total score (0.7) indicates low variability across all the total scores.

Table 17. Descriptive Statistics of Mindful Attention Awareness Scale (MAAS)

Descriptive Statistics								
	M1.1	M1.2	M1.3	M1.4	M1.5	M1.6	M1.7	M1.8
Valid	76	76	76	76	76	76	76	76
Mean	4.6	4.9	4.4	4	4.1	3.8	4.5	4.5
Median	5	5	5	4	4	4	5	5
Mode	6 ^a	6 ^a	5 ^a	6 ^a	4 ^a	4 ^a	5 ^a	5 ^a
Std. Deviation	1.3	1.3	1.4	1.6	1.4	1.5	1.4	1.3
Minimum	1	1	1	1	1	1	1	1
Maximum	6	6	6	6	6	6	6	6

	M1.9	M1.10	M1.11	M1.12	M1.13	M1.14	M1.15	Total Mean
Valid	76	76	76	76	76	76	76	76
Mean	3.9	4.8	3.4	5.1	3.1	4.2	5.1	4.3
Median	4	5	3	6	3	4	5.5	4.2
Mode	4 ^a	6 ^a	3 ^a	6 ^a	2 ^a	3 ^a	6 ^a	4.6
Std. Deviation	1.3	1.1	1.4	1.3	1.5	1.4	1.2	0.7
Min.	1	2	1	1	1	1	1	2.2
Max.	6	6	6	6	6	6	6	5.5

^aThe mode is computed assuming that variables are discrete

4.7 Descriptive Analysis of the Montreal Cognitive Assessment (MoCA)

The participants were verbally assessed on the attention and delayed recall sections of the MoCA. **Table 18** shows the descriptive statistics of each assessed section and the total score. The MoCA total score ranges from 0 to 11. The attention subtest ranges from 1 to 6, and the recall subtest ranges from 0 to 5. The mean of the attention subtest is 5.1, indicating that the participants scored well on this task. The standard deviation is low, meaning that the scores are closer to the mean and uniform across participants. The mean of the delayed recall subtest is 3.1, meaning some participants had more difficulty recalling information. The standard deviation is

higher for this subtest (1.4), indicating more variability in the recall abilities. The last column presents the mean for the total score of MoCA: 8.2 out of 11.

Table 18. Descriptive Statistics of the Montreal Cognitive Assessment (MoCA)

Descriptive Statistics			
	M2. Attention	M2.D. Recall	MoCA Total
Valid	76	76	76
Mean	5.1	3.1	8.2
Std. Deviation	1.1	1.4	2
Minimum	1	0	1
Maximum	6	5	11

4.8 Correlation Between Cognitive and Attentional Abilities and Memory Retention

In addition, to find a relationship between MAAS, MoCA, and memory retention scores, *Pearson's* correlation was conducted. The correlation table can be examined in **Table 19**. According to *Pearson's* r , for MoCA and MAAS are very close to zero, and the p-value is greater than 0.05. This indicates that there is no significant correlation between the two baseline tests. *Pearson's* r for memory retention score and MOCA is 0.3, a positive low correlation, with a p-value less than 0.05, making it statistically significant. The 0.3 coefficient suggests that as one increases, the other tends to increase as well, however, the relationship is not strong. Lastly, *Pearson's* r for memory retention and MAAS score is 0.2 with a p-value greater than 0.05, indicating a positive, low correlation.

Table 19. *Pearson's* Correlation Between MAAS, MoCA, and Memory Retention Scores

Variable		MAAS	MOCA	Memory Retention Score
1. MAAS	<i>Pearson's</i> r	—		
	p-value	—		
2. MOCA	<i>Pearson's</i> r	-3.2×10^{-2}	—	
	p-value	0.8	—	
3. Memory Retention Score	<i>Pearson's</i> r	0.2	0.3*	—
	p-value	0.2	1.9×10^{-2}	—

* $p < .05$

The results chapter has provided a comprehensive description of the data collected and the significant statistical outcomes. In the following chapter, the significance of these findings is discussed and interpreted within the broader context of the theoretical frameworks and existing literature. Moreover, the discussion chapter responds to the research questions, proving or disproving the hypotheses.

CHAPTER V

DISCUSSION

This is a pioneer study in exploring the impact of multisensory experiences on memory retention, specifically in simulated cafe environments. This study aims to address the large gap in the literature of multisensory design in public spaces by integrating visual, auditory, and olfactory stimuli in a controlled experimental setting. This gap exists due to the predominant prioritization of visual-centric design in both applied architecture and research (Pallasmaa, 2012; Spence, 2020). Grounded in the foundational theoretical frameworks of the Multi-Store Memory Model (Atkinson and Shiffrin, 1968), Dual Coding Theory (Paivio, 1986), and Multisensory Integration Theory (Ayres, 1979), the results of the study provide strong empirical evidence regarding the positive impacts of multisensory stimuli on individuals. Elaborating on the existing research in the interdisciplinary fields of architecture, neurosciences, and psychology, this study contributes to the knowledge of the impact of multisensory experiences on memory retention in cafe settings through its statistically significant findings.

The conceptualization of the research was grounded on theoretical foundations. The Multi-Store Memory Model (Atkinson & Shiffrin, 1968) provides valuable information regarding the three stores of memory: SM, STM, and LTM. The results of the study confirm the notion that multisensory stimulation enhances attentional capture at the initial memory store, SM. It guides the encoding into STM and, eventually, LTM. In addition, the Dual Coding Theory (Paivio, 1986) prescribes that information processed by verbal and non-verbal modes produces more active traces of memory due to multiple retrieval paths. The multisensory

stimuli utilized in this research utilize multiple senses, visual, auditory, and olfactory, creating those paths. Like Paivio's claim, Shams and Sheitz (2008) also stated that multimodal inputs enrich memory by engaging different but complementary neural paths.

Moreover, the findings of the study confirm the Multisensory Integration Theory (Ayres, 1979). This theory asserts that the integration of sensory modalities produces adaptive responses to an environment and forms enhanced perceptions (Ayres, 1979; Chandrasekaran, 2017). In the research, participants who were exposed to all three stimuli, visual, auditory, and olfactory, recorded the highest memory retention scores. This finding confirms that integrating senses into environments evokes greater cognitive processing. Likewise, Malhotra and Abrol (2024) mentioned that large neural networks are activated by a richer multisensory presence. Additionally, congruency of the stimuli with one another is validated by Thelen et al. (2015), who asserted that congruent stimuli lead to deeper memory encoding.

This study connects theory to practice by incorporating insights from environmental psychology and place attachment research studies. Cafes, often referred to as 'third places,' act as informal social hubs outside of the home and workplace, providing both public access and personal comfort (Oldenburg, 1999; Waxman, 2006). These characteristics make cafes particularly valuable environments for exploring multisensory design. Previous studies highlight that visitors prefer cafe environments with rich sensory elements, such as the smell of coffee, natural lighting, and tactile materials. These sensory elements foster emotional connections and cultural significance (Waxman, 2006; Bilgiç & Şahin, 2021). This research builds on those findings by demonstrating that environments rich in sensory experiences can significantly enhance memory performance.

This study went beyond theoretical models since it conducted a mixed-method experimental design under controlled conditions. Through a well-constructed methodology incorporating both quantitative and qualitative data, the internal validity of the findings was strengthened to assert a causal relationship between multisensory stimuli and memory retention. The framework constitutes the multisensory experience as an independent variable and memory retention as the

dependent variable. The findings of the study demonstrate that public environments designed with the convergence of sensory modalities, specifically visual, auditory, and olfactory, can significantly enhance the memory retention of adults. The memory retention results retrieved from the convergence of three sensory modalities dominate single and dual-sensory experiences. These outcomes strengthen existing cognitive theories and offer notable contributions to the related fields.

The experimental study was conducted in an indoor controlled environment in Ankara, Türkiye, utilizing a digital screen for viewing a cafe environment image, speakers for auditory cues, and a bottle of coffee as the olfactory cue. The participants were 76 adults aged 18-65, 40 males and 36 females, residing in Ankara. The participants had strict inclusion and exclusion criteria and were equally distributed across the four sensory groups. All the participants went through eight consecutive stages: an informed consent form, a demographic questionnaire, the MAAS, the MoCA, one of the four sensory experiences, a distraction puzzle task, a memory retention task, and visual and auditory tests. The results were analyzed qualitatively through thematic content analysis on eight categories and quantitatively using t-tests, ANOVA, and Pearson's correlation in JASP 0.18.3.0.

5.1 Demographic Distribution and Baseline Measures

The demographic analysis represents an approximately even gender mix of the vast majority of groups, though there were more males represented in the visual and auditory groups. Both age distribution and educational background varied. A majority of the participants were between the ages of 25 and 44. Regarding education levels, 60.5 percent of the participants have received their undergraduate degrees. Each sensory group was distributed with randomized varieties of participants. This variation in the demographic insights suggests a diverse sample of participants, strengthening the generalizability of the findings.

The baseline cognitive and mindfulness scores were consistent and solid across the participants. The MAAS baseline test had an average mindfulness score of 4.3 out of 6. This indicates moderate to high attention levels. Moreover, the MoCA mean of 8.2 out of 11 confirmed adequate cognitive functions.

5.2 Memory Retention Scores and Sensory Modalities

The qualitative and quantitative findings support **H1** and **H2**, stating that multisensory experiences significantly enhance memory retention. The dual-sensory and the triple-sensory groups scored significantly higher than the unisensory groups. The visual and auditory group had a mean of 23, the visual and olfactory group had a mean of 21, and the visual, auditory, and olfactory group had a mean of 32.2. In contrast, the visual-only group had a mean of 13. Also, the independent samples T-test (**Tables 8-10**) compares each of the multisensory and unisensory groups. The T-test scores clearly show that all the multisensory groups scored significantly higher than the unisensory group. These findings support **H1**, which states that multisensory experiences in cafes lead to significantly higher memory retention compared to single-sensory environments.

These findings are found to be consistent with the existing literature. Both Madzharov et al. (2018) and Yildirim et al. (2024) demonstrated the potential impact of olfactory stimuli on cognitive performance. Moreover, Mehta et al. (2012) concluded that moderate auditory stimuli engage individuals to higher levels of thinking, which influences cognitive performance. Consistent with what the statistical data shows, both dual-sensory groups performed significantly better than the unisensory group.

Additionally, the independent sample tests (**Tables 12 and 13**) show that the tri-sensory group, visual, auditory, and olfactory, outperformed the dual sensory groups, visual and auditory, and visual and olfactory. To support this claim, a one-way ANOVA was conducted between groups, which concluded that at least one group's mean memory retention score significantly differed from the others. Accordingly, a custom contrast against the visual, auditory, and olfactory groups and the other three groups was conducted, confirming that the triple-sensory group scored 37.9 points higher than the average of the other three groups. To build on the ANOVA results, a post hoc Tukey comparison was conducted in **Table 16**. This analysis shows that not only did all groups perform better than the visual-only group, but the triple-sensory group also performed better than all the groups. These findings support **H2**, which states that combining visual, auditory, and olfactory stimuli will result in the most

significant enhancement of memory retention compared to dual-sensory combinations. Nonetheless, these results align with Meyerhoff & Huff (2016) and von Kriegstein & Giraud (2006), who state that engaging multiple senses leads to better memory outcomes.

While both visual and auditory and visual and olfactory groups significantly outperformed the visual group, the statistical comparisons between the two dual senses show that there is no statistically significant difference. This shows that both modalities contribute an equal amount when paired with a visual. This supports the study conducted by Pecher & Zeelenberg (2022), which highlighted that regardless of the modalities engaged, combinations of sensory experiences increase memory performance as long as they are congruent.

Moreover, the thematic content analysis of the colors, furniture, fixtures, materials, spatial remarks, accessories, numerical values, and sensory stimuli revealed that memory retention showed improvement across the different categories as more senses were stimulated. For instance, the mean of color recall increased from 0.9 in the visual group to 3.3 in the triple-sensory group. The mean of numerical values also greatly increased from 1.5 in the visual group to 5.3 in the triple-sensory group. These drastic changes in the means of each category confirm Brady et al. (2011) and Pallasmaa's (2011) emphasis on the role of multisensory encoding in strengthening visual memory. Pallasmaa (2011) also emphasized that visual memory is strengthened with the complementarity of other sensory modalities. Similarly, spatial remarks showed dramatic improvement from a mean of 1.3 in the visual group to a mean of 6.8 in the triple sensory group. This increase supports Krishna (2010), who emphasized the link between sensory engagement, spatial cognition, and perception. Despite the sensory group, the accessories and furniture categories were the most noted items, suggesting they were the easiest to encode. Although the sensory stimuli contributed to improving cognitive performance, they were the least noted category.

5.3 Cognitive Baselines and Their Correlation with Memory Performance

Beyond the sensory group comparisons, this study also analyzed the relationship between individual cognitive baseline and memory retention scores. As a result of a

Pearson's correlation (**Table 19**), it can be seen that there is a significantly low correlation between MoCA scores and memory retention. This suggests that the baseline cognitive functions aid but do not determine memory performance in multisensory experiences. An important finding in this analysis was that even participants with average or below-average cognitive scores benefited from multisensory experiences. This finding reinforces the accessibility of multisensory design benefits. For instance, Chan et al. (2005) and Martin et al. (1998) have highlighted the universality and vitality of multisensory experiences in therapeutic environments. Even though MAAS scores did not conclude to have a high correlation with the memory retention scores, the significant positive value of *Pearson's r* indicates a potential interaction for further research. Accordingly, **H3** was partially met, which stated that higher levels of memory and attention tests would be positively correlated with higher memory retention response to multisensory cafe experiences.

5.4 Comparison of Results with Previous Studies

The findings of this study align with and expand upon existing literature on multisensory experiences and their impact on cognitive functions. Consistent with the foundational theories of Multisensory Integration and Dual Coding (Ayres, 1979; Paivio, 1986), we observed statistically significant improvements in memory retention within both the triple-sensory group (visual, auditory, and olfactory) and the dual-sensory groups. This underscores the importance of combining multiple sensory modalities to enhance cognitive processing. Moreover, these results support the argument made by Shams and Seitz (2008) that multimodal inputs engage multiple neural pathways, thereby improving the depth and durability of memory traces.

Previous studies in the fields of architecture and cognition have often focused on individual sensory modalities, with a strong focus on visual-centric research (Pallasmaa, 2012; Spence, 2020). This study aims to address this gap by empirically demonstrating that pairing olfactory and auditory stimuli with visual stimuli significantly improves memory retention outcomes. These findings are in line with the work of Madzharov et al. (2018) and Yildirim et al. (2024), who reported the positive cognitive effects of olfactory stimuli. Similarly, Mehta et al. (2012)

highlighted the role of moderate auditory cues in enhancing cognitive engagement. Notably, the absence of significant differences between the dual-sensory groups further supports Pecher and Zeelenberg's (2022) findings, which suggest that congruent sensory combinations enhance memory, regardless of the specific modalities involved.

The superior memory retention observed in the triple-sensory group aligns with the findings of Malhotra and Abrol (2024), who emphasized that richer multisensory environments activate larger neural networks, leading to improved cognitive outcomes. Similarly, the results support the work of Meyerhoff and Huff (2016) and von Kriegstein and Giraud (2006), who demonstrated that engaging multiple senses results in better memory retention.

The use of cafes as experimental environments reflects the concept of 'third place,' serving as socially and emotionally significant spaces (Oldenburg, 1999; Waxman, 2006). The bond established between people and places through multisensory design elements, such as the aroma of coffee and ambient sounds, supports previous findings by Bilgiç and Şahin (2021). Sensory-rich environments add to the emotional and cultural significance of a location.

Additionally, the low but significant positive correlation between cognitive baseline measures (MoCA scores) and memory retention supports earlier studies by Chan et al. (2005) and Martin et al. (1998). This suggests that multisensory experiences can benefit individuals with varying cognitive abilities. This finding emphasizes the accessibility of multisensory design and its potential applications in therapeutic environments. In conclusion, this research provides empirical evidence that supports and extends existing theoretical and experimental research by showing that integrating multiple senses in public spaces, such as cafes, can significantly enhance memory retention. All the hypotheses, their findings, and their consistent source can be found in **Table 20**.

Table 20. Hypotheses and Their Findings

Hypotheses	Evidence	Conclusion	Consistent With	Inconsistent With
H1: <i>Multisensory experiences in cafes will lead to significantly higher memory retention compared to single-sensory environments.</i>	Tables 6, 8, 9, 10	Hypothesis is supported.	Ayres (1979); Madzharov et al. (2018); Malhotra & Abrol (2024); Meyerhoff & Huff (2016); Paivio (1986); Pallasmaa (2011); Shams & Seitz (2008); von Kriegstein & Giraud (2006).	–
H2: <i>Combining visual, auditory, and olfactory stimuli will result in the most significant enhancement of memory retention compared to dual-sensory combinations.</i>	Tables 12, 13, 14, 15, 16	Hypothesis is supported.	Heilig (1992); Malhotra & Abrol (2024); Pallasmaa (2011); Shams & Seitz (2008); Spence et al. (2009); Thelen et al. (2015).	–
H3: <i>Higher levels of memory and attention tests will correlate positively with higher memory retention response to multisensory experiences in cafes.</i>	Table 19	Hypothesis is partially supported.	Chan et al. (2005); Martin et al. (1998).	–

Having examined the findings concerning the theoretical frameworks, existing literature, and the study's hypothesis, the discussion chapter has presented the theoretical and practical significance of multisensory experiences in enhancing memory retention in cafe settings. Accordingly, the following provides a comprehensive conclusion with the main insights of the study. It further presents limitations and possible avenues to build upon the current findings. Lastly, the concluding chapter reflects on the practical implications of the study, offering recommendations for practice to deepen the understanding of multisensory experiences.

CHAPTER VI

CONCLUSION

This study investigated the role of multisensory experiences on memory retention in public interior environments, specifically, cafe settings. Although visual aesthetics have dominated architectural and environmental design (Pallasmaa, 2011; Spence, 2020), the cognitive benefits of integrating multiple sensory modalities are neglected. This neglect specifically exists in everyday public spaces like cafes. Based on the foundational theoretical frameworks of the Multi-Store Memory Model (Atkinson & Shiffrin, 1968), Dual Coding Theory (Paivio, 1986), and Multisensory Integration Theory (Ayres, 1979), this research used a mixed-method design to investigate the impacts of visual, auditory, and olfactory stimuli on memory retention.

The findings provide strong empirical support for the hypotheses presented. Participants exposed to the multisensory group consistently outperformed those in the unisensory group across the memory retention measures. Statistical analysis confirmed this with strong significance and large effect sizes. Moreover, the t-tests, one-way ANOVA, and post hoc Tukey also proved that the visual, auditory, and olfactory groups performed better than the others. Participants in the triple-sensory group demonstrated the highest memory recall across all thematic categories, such as spatial remarks, color, and accessories. This finding underscores the significance of sensory integration in encoding various environmental attributes.

Moreover, these results support **H1**, confirming that multisensory experiences yield higher memory retention compared to unisensory environments. Additionally, **H2** was supported by the results of the triple-sensory group surpassing the two dual-

sensory groups. The studies of Shams & Seitz (2008) and Thelen et al. (2015) align with these findings, highlighting that congruent multisensory stimuli increase neural encoding and improve memory recall. This study also partially confirmed **H3**, which claimed that there would be a significant positive correlation between the baseline tests, MAAS and MoCA, and the memory retention scores. A low but significant correlation was analyzed between the MoCA and memory retention scores. This indicates that the participants with higher cognitive functioning scores had better memory retention scores in the multisensory experiences. Although the MAAS scores showed a positive trend, the relationship was not statistically significant. Such a result suggests that mindfulness may not be a strong predictor of memory performance in this context.

Aside from confirming the hypotheses, valuable insights were contributed to the literature. The results verify that multisensory design enhances cognitive performance and experiential quality. The results validate Pallasmaa's (2011) critique of visual dominance in architecture, further showing the necessity of sensory-rich environments. In addition, the findings also verify recent findings in environmental psychology and neurosciences regarding the integration of multi-modal experiences for richer and more durable traces of memory (Malhotra & Abrol, 2024; Madzharov et al., 2018).

Importantly, this study fills a significant knowledge gap in the literature. Although some studies exist on multisensory design and its benefits in educational settings, museums, or therapeutic spaces, this study proposes that cafes are meaningful cognitive environments where the surround significantly impacts user behavior, memory, and experience.

6.1 Limitations

Although the study proposes strong findings and insights, the limitations must be acknowledged. One of the limitations is that this study was conducted in a controlled indoor environment with simulated cafe settings using standardized visual, olfactory, and auditory stimuli. Standardizing the stimuli from existing literature enhanced the internal validity of the findings. However, it reduced the ecological validity. The

sensory stimuli would be less predictable and more dynamic in a real-world cafe setting. For instance, there would be fluctuating noise levels, tactile experiences, and temperature variations.

As a second limitation, this study was solely conducted on individuals residing in Ankara, Türkiye. While demographic diversity was ensured, other populations may have performed differently as a result of cultural factors or sensory preferences. Future research can extend to cross-cultural studies to investigate how cultural background modulates multisensory experiences. Additionally, this study evaluated 76 participants, 19 in each group; however, this size should be increased for generalizability in future studies.

Moreover, the baseline cognitive and attention assessments, MAAS and MoCA, had low correlations with the memory retention scores. These correlations suggest that other unmeasured variables may impact the relationship between multisensory experiences and memory retention. Among these variables can be emotional factors, sensory sensitivity, etc.

6.2 Future Research

Multisensory design can be integrated and utilized in numerous fields and areas. Multiple novelties can be sought to build upon the contributions of this study, Primarily, future research should conduct a longitudinal study where the participants should be tracked over extended periods. This method will help examine the durability of multisensory memory impacts. Although this study focuses on short-term memory retention, comprehending long-term retention may be crucial for educational and therapeutic settings.

Conducting the experiment design in a real environment and a naturalistic environment can contribute to increasing ecological validity. Incorporating variables such as crowds, fluctuating sensory cues, and social interaction can provide a more holistic understanding of the multisensory impact on memory. Since immersive digital experiences are growing in popularity, this study can also be applied in virtual or augmented reality environments.

Future studies should also seek the integration of additional senses, such as touch and gustatory. Although these two senses stand at a lower point in Heilig's (1992) hierarchy of senses regarding attentional capture (Spence, 2020), they may contribute valuable insights. These senses have particular relevance in fields such as hospitality and retail design. In such environments, tactile and gustatory experiences may impact perception and memory. Finally, future studies can expand beyond memory and explore the impact of multisensory experiences on emotions, creativity, or user satisfaction. Investigating these variables in public spaces has the potential to introduce a new layer to the design of public spaces.

This study significantly contributes to understanding how multisensory environments enhance memory retention in public spaces. Through the findings regarding cognitive benefits of visual, auditory, and olfactory stimuli, this research provides insights into incorporating multisensory elements into everyday lives. These insights provide for enriched cognitive engagement and memory retention. Related fields of interior design, psychology, cognitive neurosciences, and other stakeholders can utilize these findings to embrace multisensory design for increased cognitive performance and connections with their environments.

6.3 Implications of the Study

The implications of this study for practice are illustrated in **Figure 11**. These implications are presented in five distinct categories: physical, social, cultural, policy, and educational. In the physical category, the findings of this study can be applied to the design of physical cafe environments. It is essential to prioritize multisensory design by integrating visual, auditory, and olfactory stimuli to enhance user experience and memory retention. Ambient noise levels should be optimized to stimulate cognitive engagement while ensuring comfort. Familiar and recognizable scents can strengthen memory and improve the recall of spatial details. Ensuring sensory congruency and consistency throughout the environment is critical for delivering uniform and coherent experiences.

Under the social category, social engagement can be promoted by designing spaces that stimulate multiple senses simultaneously, encouraging longer visits and deeper

interactions. This can be achieved through varying sensory zones tailored to different user needs, such as active social areas and quiet, reflective spaces. These design elements can foster social comfort through layered and familiar sensory cues.

Moreover, sensory design should also reflect cultural sensitivity by incorporating elements that resonate with the users' cultural backgrounds, making environments more memorable and inclusive. Designers need to consider diverse sensory preferences to foster comfort and emotional connection in culturally varied settings.

From a policy perspective, integrating multisensory guidelines into public space planning is essential for supporting cognitive well-being and accessibility. Public funding and institutional support should be directed toward the development of sensory-rich community spaces that promote engagement and health.

Finally, educational initiatives and professional training programs are necessary to equip designers and stakeholders with the knowledge required to implement multisensory features effectively at appropriate scales across various environments.

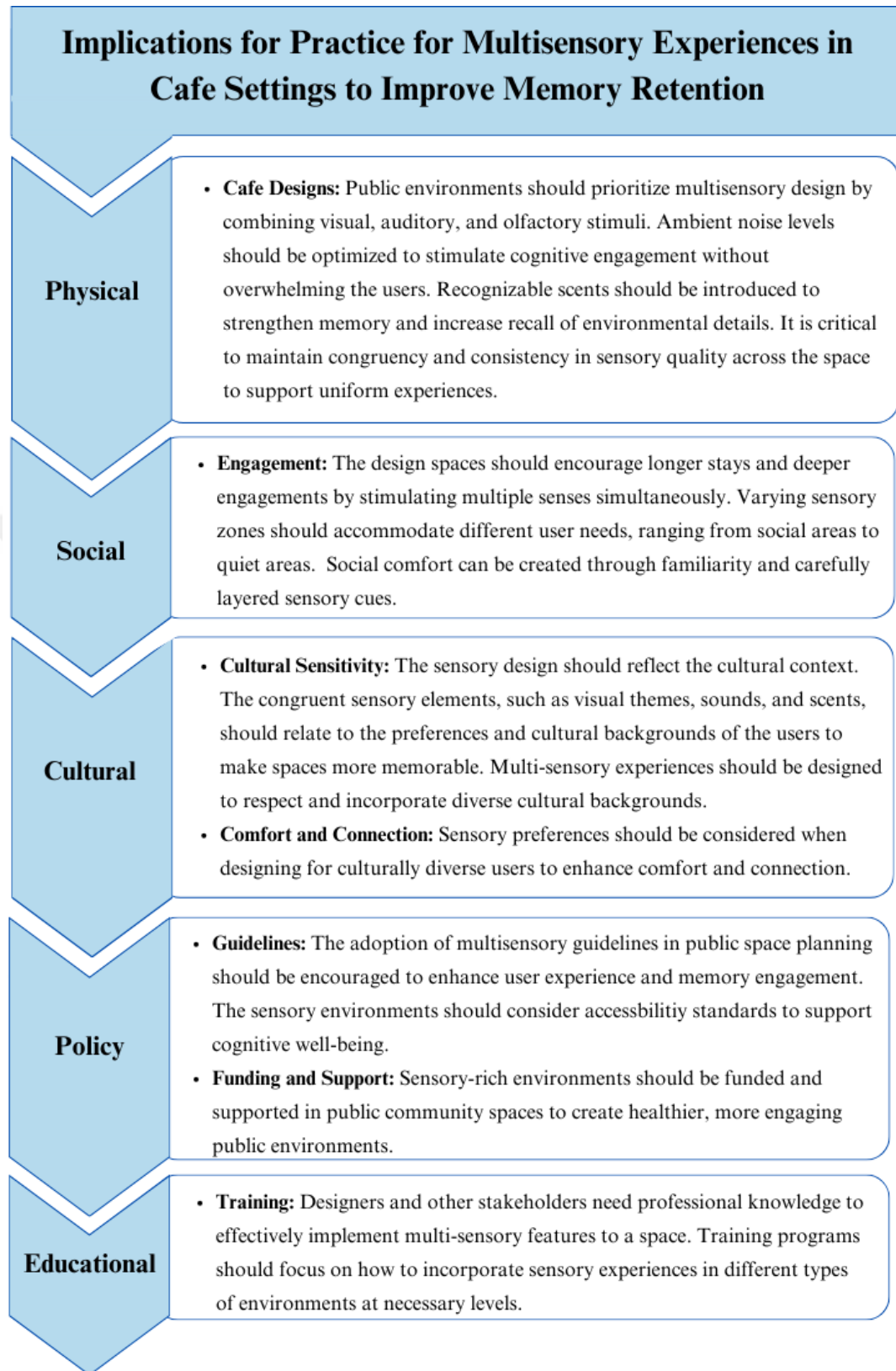


Figure 11. Implications for Practice

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APPENDICES



APPENDIX A. Approval by Bilkent University Local Ethics Committee



Bilkent Üniversitesi

AKADEMİK İŞLER REKTÖR YARDIMCILIĞI

İNSAN ARAŞTIRMALARI ETİK KURULU KARARLARI

Toplantı Tarihi : 12/03/2025
Toplantı No : İAEK_2025_03_12_02
Saat : 17:00

Üyeler: Prof. Dr. Halil Altay Güvenir (Başkan), Bilgisayar Mühendisliği
Doç. Dr. Işık Yuluğ, Moleküler Biyoloji ve Genetik
Dr. Öğr. Üyesi Burcu Ayşen Ürgen, Psikoloji
Dr. Öğr. Üyesi Şemsi Barış Özçelik, Hukuk
Uzman Öğretim Görevlisi Dr. Emine Öncüler Yayalar, Siyaset Bilimi ve Kamu Yönetimi
Prof. Dr. Özgür Ulusoy (Yedek Üye), Bilgisayar Mühendisliği
Dr. Öğr. Üyesi Pınar Altınok Ormancı (Yedek Üye), Hukuk

Gündem: 667 no.lu "The Role of ..." adlı çalışma için etik kurul onay başvurusu.

Karar: Üniversitemiz Güzel Sanatlar, Tasarım ve Mimarlık Fakültesi Öğretim Üyesi Prof. Dr. Halime Demirkan danışmanlığında, Ekonomi ve Sosyal Bilimler Enstitüsü, İç Mimarlık ve Çevre Tasarımı Ana Sanat Dalı yüksek lisans programı öğrencisi Nil Nazzal'ın 667 no.lu "The Role of Multi-Sensory Experiences on Short-Term Memory Retention in Stimulated Cafe Environments." adlı çalışma kapsamında yapmayı önerdikleri etkinliğin genel bilim etiği açısından uygun olduğuna, uygunluk verilen çalışma önerisinin karar ekinde yer alan çalışma önerisi, çalışma yürütücüleri ve bilgilendirme formu için geçerli olduğuna, toplantıya katılan üyelerin oy birliği ile karar verildi.

Prof. Dr. Halil Altay GÜVENİR Başkan Katıldı	Doç. Dr. Işık YULUĞ Üye Toplantıya Katılmadı	Dr. Öğr. Üyesi Burcu Ayşen ÜRGEN Üye Katıldı
Dr. Öğr. Üyesi Şemsi Barış ÖZÇELİK Üye Katıldı	Dr. Emine ÖNCÜLER YAYALAR Üye Katıldı	Prof. Dr. Özgür ULUSOY Yedek Üye Katıldı

Bu belge, güvenli elektronik imza ile imzalanmıştır.
Evrak doğrulama <https://ebys-dogrulama.bilkent.edu.tr/> adresinden c5196475 kodu ile yapılabilir.

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Bilgi için: Birgül BULUT
Yönetici Sekreter
Telefon No: 0 312 29012 14



1/1

Figure 1. Bilkent University Human Ethics Committee Approval

APPENDIX B. Participant Informed Consent Forms

Participant Code: _____

Title of the Study

The Role of Multisensory Experiences on Short-Term Memory Retention in Simulated Cafe Environments

Purpose of the Study

This research aims to investigate the role of multisensory experiences on short-term memory retention in interior cafe settings by examining how incorporating various sensory modalities enhances an individual's ability to retain knowledge. The sensory modalities include visual, auditory, and olfactory. Each participant undergoes one of the four groups of sensory experiences: (a) visual; (b) visual and auditory; (c) visual and olfactory; (d) visual, olfactory, and auditory. This study is related to Nil Nazzal's MFA study at Bilkent University. Adults (aged 18-65) residing in Ankara, Türkiye, will participate in the experiment using a digitally stimulated image of a cafe environment. The students who are currently enrolled in a course taught by the investigator or have the potential of being graded by the investigator will not be able to participate in this study. This study begins in February 2025.

Participation

I am a participant in this research study, and my participation is entirely voluntary. I am comfortable taking part in this study. I understand that I can withdraw from the experiment at any time by informing the investigator. Additionally, I may be excluded from the study if necessary. I can contact the investigator, the investigator's advisor, or the Bilkent University Local Ethics Committee if I have any questions regarding this research.

Procedure

As a participant in this research, I will:

1. Fill out a Demographic Questionnaire about my age, gender, education, occupation, and visual, olfactory, and auditory impairments.
2. Take two baseline examinations: the Mindful Attention Awareness Scale (MAAS) and the Montreal Cognitive Assessment (MoCA)

Figure 2a. English Informed Consent Form

3. Investigate one digital image of a cafe environment with its corresponding stimulus or stimuli provided to me
4. Solve a puzzle as a distraction task
5. Respond to an open-ended question about the simulated environment
6. Take a hearing test and the Ishihara Test for color blindness

I will be informed about each examination before taking it.

Risks and Benefits

As a participant, I will not receive any direct benefits from this study. However, the results may provide valuable insights into the field of interior design. By taking part in this research, I will assist the investigator in gathering essential data to understand how multisensory experiences influence short-term memory retention in interior cafe settings. I acknowledge that this study poses no known or anticipated risks and will not cause me any harm.

Compensation

I will not receive any compensation for participating in this research. No monetary payment or extra course credits will be provided for my involvement in this study.

Anonymity and Confidentiality

Any data collected in this research study may be reported and published for scientific purposes. However, my identity will remain confidential, and all personal information will be securely stored by the investigator for two years following the study's completion.

Figure 2a. (cont'd)

Statement of Consent

I accept that I have read and understood this form by signing below. I have asked all my questions and understand what I am being asked to do. By signing below, I accept that I am willing and would like to participate in this study.

Name of the Participant: _____

☐ I am above 18 years old.

Signature of the Participant

Date

Signature of the Investigator

Date

Signature of the Advisor

Date

Information about the Investigator:

Nil Nazzal

MFA student at Bilkent University,

Department of Interior Architecture and Environmental Design

E-mail: nil.nazzal@bilkent.edu.tr

Information about the Advisor:

Prof. Dr. Halime Demirkan,

Department of Interior Architecture and Environmental Design

E-mail: demirkan@bilkent.edu.tr

Figure 2a. (cont'd)

Katılımcı Kodu: _____

Çalışmanın Başlığı

Simüle Edilmiş Kafe Ortamlarında Çoklu Duyusal Deneyimlerin Kısa Süreli Bellek Tutulumu Üzerindeki Rolü

Çalışmanın Amacı

Bu araştırmanın amacı, iç mekân kafe ortamlarında çoklu duyusal deneyimlerin kısa süreli bellek tutulumu üzerindeki rolünü inceleyerek farklı duyusal modalitelerin bireylerin bilgi tutma yetisini nasıl geliştirdiğini araştırmaktır. Bu duyusal modaliteler görsel, işitsel ve koku duyularını kapsamaktadır. Her katılımcı, aşağıdaki dört farklı duyusal deneyim grubundan birine dahil edilecektir: (a) görsel; (b) görsel ve işitsel; (c) görsel ve koku; (d) görsel, koku ve işitsel. Bu çalışma, Nil Nazzal'ın Bilkent Üniversitesi'nde yürütmekte olduğu Yüksek Lisans (MFA) çalışması kapsamındadır. Araştırmaya Ankara, Türkiye'de yaşayan 18-65 yaş arasındaki yetişkin bireyler katılacak olup, deney, dijital olarak simüle edilmiş bir kafe ortamı görseli aracılığıyla gerçekleştirilecektir. Araştırmacı tarafından verilen bir derse halihazırda kayıtlı olan veya araştırmacı tarafından notlandırılma ihtimali bulunan öğrenciler bu çalışmaya katılamayacaktır. Bu çalışma Şubat 2025'te başlayacaktır.

Katılım

Bu araştırmaya katılımcı olarak dâhil oluyorum ve katılımım tamamen gönüllülük esasına dayanmaktadır. Bu çalışmaya katılmak konusunda rahatım. Araştırmacıyı bilgilendirerek istediğim zaman bu deneyden çekilebileceğimi anladım. Ayrıca, gerekli görüldüğü takdirde çalışmadan çıkarılabilirim. Bu araştırmayla ilgili herhangi bir sorum olması halinde, araştırmacı, araştırmacının danışmanı veya Bilkent Üniversitesi Yerel Etik Kurulu ile iletişime geçebilirim.

Prosedür

Bu araştırmaya katılımcı olarak:

1. Yaş, cinsiyet, eğitim durumu, meslek ve görme, koku ve işitme engellerine ilişkin bilgilerimi içeren bir Demografik Anket dolduracağım.

Figure 2b. Turkish Informed Consent Form

2. Bilinçli Dikkat Farkındalığı Ölçeği (MAAS) ve Montreal Bilişsel Değerlendirme (MoCA) testlerini tamamlayacağım.
3. Belli bir uyaran veya uyaranlar eşliğinde bana sunulan dijital bir kafe ortamı görselini inceleyeceğim.
4. Bir dikkat dağıtma görevi olarak bulmaca çözeceğim.
5. Simüle edilmiş ortamla ilgili açık uçlu bir soruya yanıt vereceğim.
6. Bir işitme testi ve renk körlüğünü belirlemek için Ishihara Testi'ni tamamlayacağım.

Her testten önce bana gerekli bilgilendirme yapılacaktır.

Riskler ve Faydalar

Bu çalışma kapsamında herhangi bir doğrudan fayda elde etmeyeceğimi kabul ediyorum. Ancak, elde edilecek sonuçlar iç mimarlık alanına katkı sağlayabilir. Bu araştırmaya katılarak, çoklu duyuşal deneyimlerin kısa süreli bellek tutulumu üzerinde etkisini anlamaya yönelik veri toplama süreçlerine destek oluyorum. Araştırmanın bilinen veya öngörülebilir herhangi bir riski bulunmamaktadır ve bana zarar vermeyecektir.

Karşılık

Bu araştırmaya katılım için herhangi bir ödeme almayacağım. Katılım karşılığında maddi çıkar veya ekstra ders kredisi sağlanmayacaktır.

Anonimlik ve Gizlilik

Bu araştırma kapsamında toplanan veriler bilimsel amaçlarla raporlanabilir ve yayınlanabilir. Ancak, kimliğim gizli tutulacak ve tüm kişisel bilgilerim, araştırmanın tamamlanmasından sonra iki yıl boyunca güvenli bir şekilde araştırmacı tarafından saklanacaktır.

Figure 2b. (cont'd)

Onay Beyanı

Bu belgeyi imzalayarak, bu formu okuduğumu ve anladığımı kabul ediyorum. Tüm sorularımı sordum ve benden ne istendiğini anlıyorum. Bu belgeyi imzalayarak, bu çalışmaya kendi isteğimle katılmayı kabul ettiğimi beyan ediyorum.

Katılımcının Adı: _____

☐ 18 yaşından büyüğüm.

Katılımcının İmzası

Tarih

Araştırmacının İmzası

Tarih

Danışmanın İmzası

Tarih

Araştırmacı Bilgileri:

Nil Nazzal

Bilkent Üniversitesi, İç Mimarlık ve Çevre Tasarımı Bölümü, MFA Öğrencisi

E-posta: nil.nazzal@bilkent.edu.tr

Danışman Bilgileri:

Prof. Dr. Halime Demirkan

Bilkent Üniversitesi, İç Mimarlık ve Çevre Tasarımı Bölümü

E-posta: demirkan@bilkent.edu.tr

Figure 2b. (cont'd)

APPENDIX C. GPower Analysis

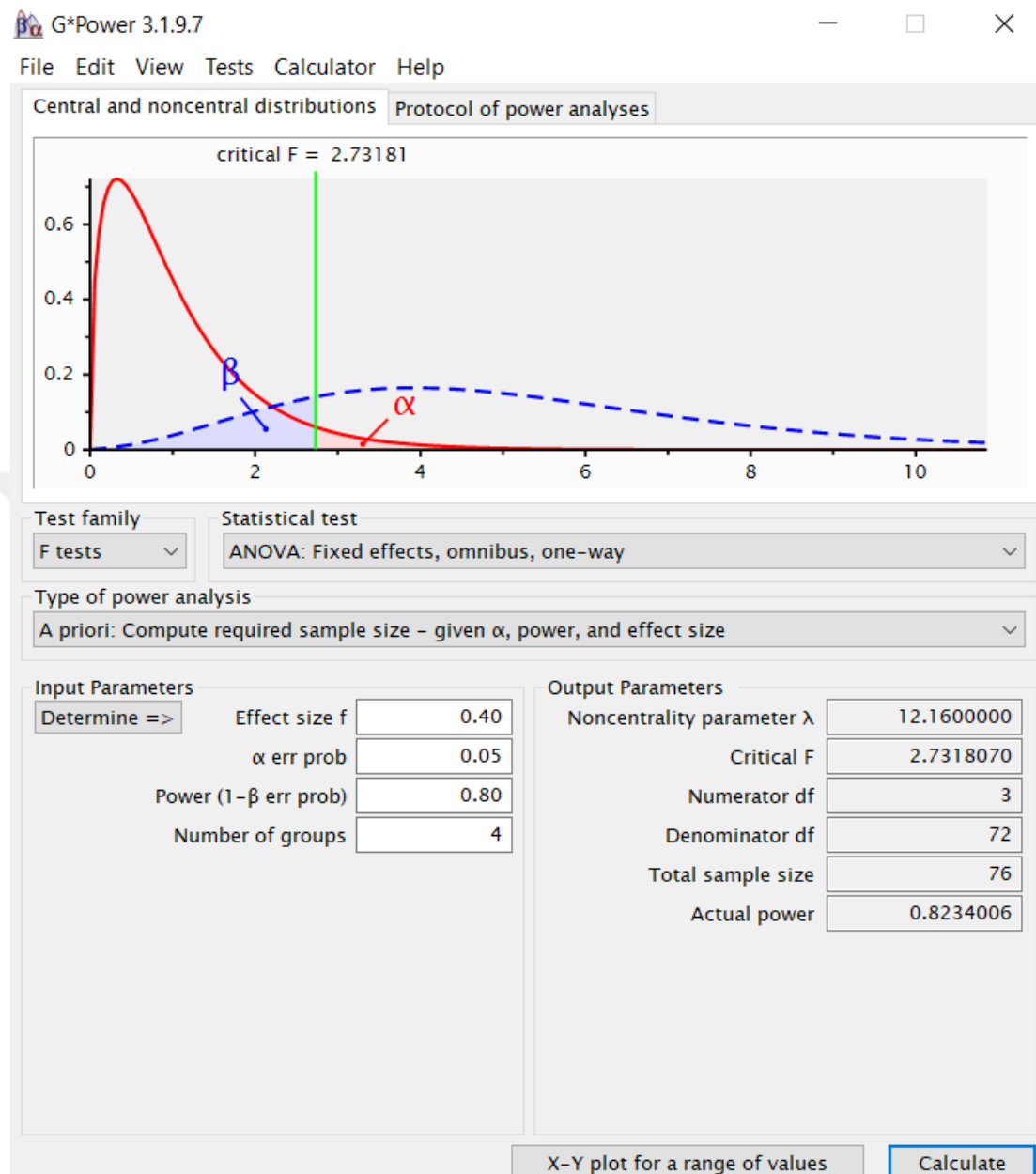


Figure 3. GPower Analysis for Sample Size Calculation

APPENDIX D. Demographic Questionnaire

1	Name/Participant Number	
2	Preferred Experiment Language	
3	Gender	
4	Age	
5	Marital Status	
6	Nationality	
7	Education Level	
8	Occupation	

		Yes	No	If yes, is it corrected and how?
9	Do you have visual impairments?			
10	Do you have auditory impairments?			
11	Do you have olfactory impairments?			
12	Do you have cognitive impairments?			
13	Do you have a Body Mass Index (BMI) higher than 30?			

14	Have you consumed any of the following 24 hours before the experiment?	__ coffee	__ alcohol	__ tobacco	__ drugs or supplements
15	How many cups of coffee do you consume per week?				

Figure 4a. English Demographic Questionnaire

1	Ad / Katılımcı Numarası	
2	Tercih Edilen Deney Dili	
3	Cinsiyet	
4	Yaş	
5	Medeni Durum	
6	Uyruk	
7	Eğitim Seviyesi	
8	Meslek	

		Evet	Hayır	Eğer 'Evet' yanıtını verdiyseniz, bu durum düzeltilmiş mi? Eğer düzeltilmişse, hangi yöntemle?
9	Görme bozukluğunuz var mı?			
10	İşitme bozukluğunuz var mı?			
11	Koku alma duyunuzda bir bozukluk var mı?			
12	Bilişsel bir bozukluğunuz var mı?			
13	Vücut Kitle İndeksiniz (VKİ) 30'un üzerinde mi?			

14	Deneyden önceki 24 saat içinde aşağıdaki maddelerden herhangi birini tükettiniz mi?	__ kahve	__ alkol	__ tütün	__ uyuşturucu madde veya ilaç takviyesi
15	Haftada kaç fincan kahve tüketiyorsunuz?				

Figure 4b. Turkish Demographic Questionnaire

APPENDIX E. The Mindful Attention Awareness Scale (MAAS)

The Mindful Attention Awareness Scale (MAAS)

The trait MAAS is a 15-item scale designed to assess a core characteristic of mindfulness, namely, a receptive state of mind in which attention, informed by a sensitive awareness of what is occurring in the present, simply observes what is taking place.

Brown, K.W. & Ryan, R.M. (2003). The benefits of being present: Mindfulness and its role in psychological well-being. *Journal of Personality and Social Psychology*, 84, 822-848.

Carlson, L.E. & Brown, K.W. (2005). Validation of the Mindful Attention Awareness Scale in a cancer population. *Journal of Psychosomatic Research*, 58, 29-33.

Instructions: Below is a collection of statements about your everyday experience. Using the 1-6 scale below, please indicate how frequently or infrequently you currently have each experience. Please answer according to what really reflects your experience rather than what you think your experience should be. Please treat each item separately from every other item.

	1	2	3	4	5	6
	almost always	very frequently	somewhat frequently	somewhat infrequently	very infrequently	almost never
_____ 1.						
	I could be experiencing some emotion and not be conscious of it until some time later.					
_____ 2.						
	I break or spill things because of carelessness, not paying attention, or thinking of something else.					
_____ 3.						
	I find it difficult to stay focused on what's happening in the present.					
_____ 4.						
	I tend to walk quickly to get where I'm going without paying attention to what I experience along the way.					
_____ 5.						
	I tend not to notice feelings of physical tension or discomfort until they really grab my attention.					
_____ 6.						
	I forget a person's name almost as soon as I've been told it for the first time.					
_____ 7.						
	It seems I am "running on automatic," without much awareness of what I'm doing.					
_____ 8.						
	I rush through activities without being really attentive to them.					
_____ 9.						
	I get so focused on the goal I want to achieve that I lose touch with what I'm doing right now to get there.					
_____ 10.						
	I do jobs or tasks automatically, without being aware of what I'm doing.					
_____ 11.						
	I find myself listening to someone with one ear, doing something else at the same time.					
_____ 12.						
	I drive places on 'automatic pilot' and then wonder why I went there.					
_____ 13.						
	I find myself preoccupied with the future or the past.					
_____ 14.						
	I find myself doing things without paying attention.					
_____ 15.						
	I snack without being aware that I'm eating.					

Scoring: To score the scale, simply compute a mean (average) of the 15 items.

Figure 5a. Mindful Attention Awareness Scale (MAAS) (Brown & Ryan, 2003)

	1	2	3	4	5	6
	hemen hemen her zaman	çok sık	oldukça sık	oldukça seyrek	çok seyrek	hemen hemen hiç
_____1.	Bazı duygular yaşıyor ve bir süre bunun farkına varmamış olabiliyorum.					
_____2.	İtina etmediğimden, dikkatsizlikten ya da o sırada başka bir şey düşündüğümünden eşyaları kırdığım ya da etrafa saçtığım olur.					
_____3.	Bir şey olurken, o anda olanlara odaklanmakta güçlük çekerim					
_____4.	Gideceğim yere, yol boyunca yaşadıklarımı dikkat etmeden, hızlıca yürümeye meyilliyimdir					
_____5.	Gerçekten dikkatimi çekmediği sürece, fiziksel gerginlik veya rahatsızlık hislerinin farkına varmam.					
_____6.	Birinin adını neredeyse bana ilk söylendiği anda unuturum.					
_____7.	Ne yaptığımın pek farkında olmadan otomatik yaşıyor gibiyim.					
_____8.	Ne yaptığımın farkında olmadan günlük işlere koştururum.					
_____9.	Başarmak istediğim hedefe öyle odaklanırım ki, ona ulaşmak için o an ne yaptığımın farkına bile varmam.					
_____10.	İşleri veya görevleri, otomatik olarak, ne yaptığımın farkına varmadan yaparım.					
_____11.	Kendimi, bir kulağımla karşımdakini dinleyip, aynı anda başka bir şey yaparken bulurum.					
_____12.	Arabayı bir yerlere otomatik pilotta gibi sürer, sonra oraya neden gittiğime şaşırıyorum.					
_____13.	Kendimi, gelecek ya da geçmişle uğraşırken bulurum.					
_____14.	Kendimi dikkatimi vermeden bir şeyler yaparken bulurum.					
_____15.	Ne yediğimin farkında olmadan atıştırırım.					

Figure 5b. Mindful Attention Awareness Scale (MAAS) (Brown & Ryan, 2003)
Turkish Translation (Catak, 2012).

APPENDIX F: Montreal Cognitive Assessment (MoCA)

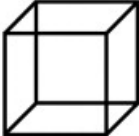
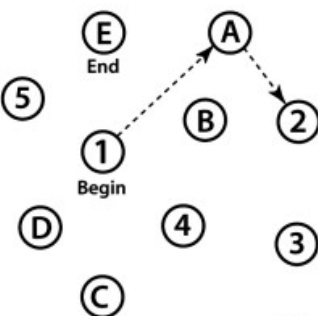
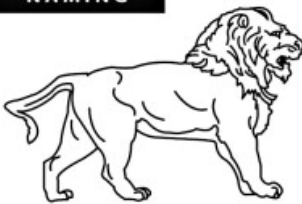
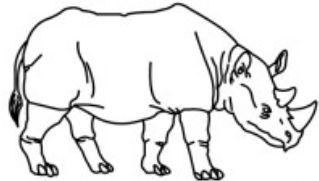
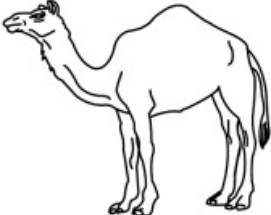
MONTREAL COGNITIVE ASSESSMENT (MOCA) Version 7.1 Original Version						NAME: _____		Education: _____		Date of birth: _____																									
						Sex: _____		DATE: _____																											
VISUOSPATIAL / EXECUTIVE						 Copy cube []		Draw CLOCK (Ten past eleven) (3 points) []		POINTS ____/5																									
																																			
NAMING						 []		 []		 []		____/3																							
MEMORY						Read list of words, subject must repeat them. Do 2 trials, even if 1st trial is successful. Do a recall after 5 minutes.		<table border="1" style="width: 100%; text-align: center;"> <tr> <td></td> <td>FACE</td> <td>VELVET</td> <td>CHURCH</td> <td>DAISY</td> <td>RED</td> </tr> <tr> <td>1st trial</td> <td></td> <td></td> <td></td> <td></td> <td></td> </tr> <tr> <td>2nd trial</td> <td></td> <td></td> <td></td> <td></td> <td></td> </tr> </table>			FACE	VELVET	CHURCH	DAISY	RED	1st trial						2nd trial						No points							
	FACE	VELVET	CHURCH	DAISY	RED																														
1st trial																																			
2nd trial																																			
ATTENTION						Read list of digits (1 digit/ sec.). Subject has to repeat them in the forward order [] 2 1 8 5 4 Subject has to repeat them in the backward order [] 7 4 2		____/2																											
Read list of letters. The subject must tap with his hand at each letter A. No points if ≥ 2 errors [] FBACMNAAJKLBAFAKDEAAAJAMOF AAB																																			
LANGUAGE						Repeat: I only know that John is the one to help today. [] The cat always hid under the couch when dogs were in the room. []		____/2																											
Fluency / Name maximum number of words in one minute that begin with the letter F [] ____ (N ≥ 11 words)																																			
ABSTRACTION						Similarity between e.g. banana - orange = fruit [] train - bicycle [] watch - ruler		____/2																											
DELAYED RECALL						<table border="1" style="width: 100%; text-align: center;"> <tr> <td>Has to recall words</td> <td>FACE</td> <td>VELVET</td> <td>CHURCH</td> <td>DAISY</td> <td>RED</td> </tr> <tr> <td>WITH NO CUE</td> <td>[]</td> <td>[]</td> <td>[]</td> <td>[]</td> <td>[]</td> </tr> <tr> <td>Category cue</td> <td></td> <td></td> <td></td> <td></td> <td></td> </tr> <tr> <td>Multiple choice cue</td> <td></td> <td></td> <td></td> <td></td> <td></td> </tr> </table>		Has to recall words	FACE	VELVET	CHURCH	DAISY	RED	WITH NO CUE	[]	[]	[]	[]	[]	Category cue						Multiple choice cue						Points for UNCUE recall only		____/5	
Has to recall words	FACE	VELVET	CHURCH	DAISY	RED																														
WITH NO CUE	[]	[]	[]	[]	[]																														
Category cue																																			
Multiple choice cue																																			
Optional																																			
ORIENTATION						[] Date [] Month [] Year [] Day [] Place [] City		____/6																											
© Z.Nasreddine MD www.mocatest.org Normal ≥ 26 / 30						TOTAL ____/30 Add 1 point if ≤ 12 yr edu																													
Administered by: _____																																			

Figure 6a. Montreal Cognitive Assessment (MoCA) (Nasreddine et al., 2005)

MONTREAL BİLİŞSEL DEĞERLENDİRME ÖLÇEĞİ
Montreal Cognitive Assessment (MOCA)

İsim:
Eğitim:
Cinsiyet:

Protokol:
Test Tarihi:
Doğum Tarihi:

GÖRSEL MEKANSAL / YÖNETİCİ İŞLEVLER		Küp Kopyalama		SAAT çizme (On biri on geçe) (3 puan)		PUAN
				Çevresi [] Rakamlar [] Kollar []		___/5
ADLANDIRMA						
						___/3
BELLEK		BURUN KADİFE CAMİ PAPATYA MOR		Puan yok		
Kelime listesini okuyun ve hastaya tekrar ettirin. İki deneme yapın. 5 dakika sonra tekrar sorun.		1. deneme 2. deneme				
DİKKAT		Sayı listesini okuyun (1 sayı / san.) Hasta sayıları baştan sona doğru saymalı Hasta sayıları sondan başa doğru saymalı		[] 2 1 8 5 4 [] 7 4 2		___/2
Harf listesini hastaya okuyun. Hastaya her A harfi okunduğunda masaya eli ile vurmasını söyleyin. İki veya daha fazla hata var ise puan vermeyin.		[] FBACMNAAJKLBAFAKDEAAAJAMOF AAB				___/1
100 den başlayarak yedişer çıkarma		[] 93 [] 86 [] 79 [] 72 [] 65		4 veya 5 doğru çıkarma: 3 puan, 2 veya 3 doğru çıkarma: 2 puan, 1 doğru :1 puan, 0 doğru 0 puan.		___/3
LİSAN		Tekrar ettirin: Tek bildiğim bugün yardıma ihtiyacı olan kişinin Ahmet olduğudur. Köpekler odadayken kedi hep kanapenin altında saklanırdı.		[] []		___/2
Akıcılık / 1 dakikada K harfi ile başlayan maksimum sayıda kelime saydırın.		[] N ≥ 11 kelime				___/1
SOYUT DÜŞÜNME		Benzerlik. Örn. muz-portakal = meyve. [] tren - bisiklet [] saat - cetvel				___/2
GEÇİKMELİ HATIRLAMA		BURUN KADİFE CAMİ PAPATYA MOR		Sadece İPUCUSUZ hatırlanan kelimeler için puan verin		___/5
SEÇMELİ		Kelimeleri İPUCU OLMADAN hatırlama Kategori ipucu Çoklu seçmeli ipucu				
YÖNELİM		[] Gün [] Ay [] Yıl [] Gün adı [] Yer [] Şehir				___/6
© Z.Nasreddine MD Version November 7, 2004 www.mocatest.org Normal 21 / 30		TÜRKÇE versiyon 2009. K. Selekler & B. Cangöz		TOPLAM		___/30

Figure 6b. Montreal Cognitive Assessment (MoCA) (Nasreddine et al., 2005)
Turkish Translation (Selekler and Cangöz, 2009).

APPENDIX G: Content Analysis Matrix Layout: Participant Responses

G.	#	Colors	Furniture	Fixtures	Materials/Forms	Spatial Remarks	Accessories	Numerical Values	Sensory Stimuli	Total
Visual	1	green plants	tables	-	-	-	"good vibes only"	-	-	10
			chairs				oat jar			
							coffee jar			
							plants			
							coffee machine			
							price tags			
							pasteries			
	2	green chairs	chairs	pendant lamps	-	jar location	"good vibes only"	9 pendant lamps	-	8
		brown chairs					pasteries			
	3	brown chairs	tables	pendant lamps	-	niche location	plants	3 large niches	-	10
		green, brown, cream color scheme	chairs			tables and chairs at center		4 chairs at center		
			service counter							
	4	green chairs	tables	pendant lamps	-	plants from ceiling	"good vibes only"	-	-	11
		white service counter	chairs				plants			
			service counter				coffee machine			
							"coffee" text			
	5	green chairs	tables	pendant lamps	wood floor	plants from ceiling	"good vibes only"	4 chairs at center	-	24
		white service counter	chairs			tables and chairs at center	coffee jar	5 bar stools		
			service counter				sugar jar	6 pendants		
		white table	bar stools			pendants above service counter	coffee machine	2 tables at center		
						text on left wall	price tags			
							desserts			
							menu			
	6	green chairs	tables	pendant lamps	wood	plants from ceiling	desserts	-	-	20
		white service counter	chairs	wall lamps		suspended ceiling	coffee machine			
			service counter				plants			
			bar stools				menu			
			backless stools				price tags			
			banquette seating				espresso frame			
			glass fridge							
	7	green chairs	tables	pendant lamps	wood floor	plants from ceiling	"good vibes only"	6 pendants	-	18
		white service counter	chairs		wood furniture		coffee machine	5 bar stools		
			service counter				plants	2 menus		
			bar stools				menu			
			banquette seating							
	8	-	tables	-	-	tables and chairs at center	plants	2 tables at center	-	12
			service counter			plants from ceiling	"coffee" text	3 backless stools		
			bar stools			left wall counter				
			backless stools							
			working counter							
	9	-	service counter	pendant lamps	-	-	plants	-	-	6
			glass fridge				pasteries			
							menu			
	10	-	-	-	-	-	"good vibes only"	-	-	4
							price tags			
							desserts			
							espresso frame			
	11	green chairs	tables	pendant lamps	wood floor	jar location	"good vibes only"	5 bar stools	-	22
		white service counter	chairs	spotlights	wood furniture		oat jar	6 pendants		
			service counter				coffee jar			
		brown elements	bar stools				sugar jar			
		white ceiling	glass fridge				pasteries			
							espresso frame			

Figure 7a. Content Analysis Matrix Layout: Participant Responses of the Visual Group

G.	#	Colors	Furniture	Fixtures	Materials/Forms	Spatial Remarks	Accessories	Numerical Values	Sensory Stimuli	Total
Visual	12	-	tables chairs service counter bar stools backless stools	pendant lamps wall lamps spotlights	wood floor	plants from ceiling wall niches	coffee jar plants pasteries espresso frame	5 bar stools 6 pendants 3 backless stools 3 types of chairs 5 spotlights 4 tables	-	21
			5	3	1	2	4	6		
	13	-	chairs service counter bar stools working counter	pendant lamps	wood floor	jar location left wall counter	oat jar coffee jar plants coffee machine pasteries menu espresso frame cookie jar	5 bar stools 2 menus	-	18
			4	1	1	2	8	2		
	14	-	tables chairs service counter bar stools working counter	pendant lamps sink and faucet	wood floor	-	coffee jar coffee machine price tags pasteries menu espresso frame cookie jar cup	5 bar stools 2 menus	-	18
			5	2	1		8	2		
	15	-	tables chairs service counter backless stools	pendant lamps spotlights	-	jar location wall niches frame location	coffee jar sugar jar pasteries espresso frame	5 bar stools 2 menus	-	15
			4	2		3	4	2		
	16	-	tables chairs service counter bar stools backless stools	pendant lamps wall lamps	-	tables and chairs at center	coffee machine pasteries cookie jar	4 chairs at center 2 tables at center	-	13
			5	2		1	3	2		
	17	-	tables chairs service counter glass fridge	-	-	-	plants menu espresso frame cookie jar	-	-	8
			4				4			
	18	-	tables chairs bar stools glass fridge counter cabinets	pendant lamps spotlights	-	-	"good vibes only" plants price tags	-	-	10
			5	2			3			
	19	-	tables chairs bar stools glass fridge shelves	pendant lamps spotlights sink and faucet	-	tables and chairs at center	coffee jar coffee machine pasteries espresso frame cookie jar	-	-	14
			5	3		1	5			

Figure 7a. (cont'd)

G.	#	Colors	Furniture	Fixtures	Materials/Forms	Spatial Remarks	Accessories	Numerical Values	Sensory Stimuli	Total
Visual + Auditory	20	green plants	tables	pendant lamps	-	tables and chairs at center	"good vibes only"	6 pendants	background noise	21
		green chairs	chairs	sink and faucet		plants from ceiling	pasteries			
		brown chairs	service counter			pendants above service counter	espresso frame			
			banquette seating			suspended ceiling				
			glass fridge			glass fridge location				
		3	5	2		5	4	1	1	
	21	green chairs	tables	pendant lamps	-	plants from ceiling	"good vibes only"	6 pendants		23
			chairs	wall lamps		pendants above service counter	oat jar	14 chairs		
			service counter			suspended ceiling	coffee jar	12 lamp fixtures		
			banquette seating				sugar jar	5 jars		
		1	4	2		3	9	4	-	
	22	brown banquette seating	tables	pendant lamps	-		oat jar	4 tables	background noise	23
			chairs	wall lamps			coffee jar	5 jars	clinking of plates and forks	
			bar stools				sugar jar	3 coffee jars		
			banquette seating				plants	1 sugar jar		
		1	4	2			pasteries	1 oat jar		
Visual + Auditory	23				-		"coffee" text			2
							menu			
							espresso frame			
							cookie jar			
		1	4	2			9	5		
	24	green chairs	tables	pendant lamps	wood floor	left wall counter			background noise	16
		green, brown, cream color scheme	chairs	wall lamps		spacious				
			service counter	spotlights		harmonious				
			bar stools							
			backless stools							
Visual + Auditory	25		working counter							1
		2	6	3	1	3				
	26	green plants	tables	pendant lamps	glass	plants from ceiling	"good vibes only"			21
		green chairs	chairs	wall lamps	gold lamps		coffee jar			
		brown chairs	service counter				sugar jar			
		green frame	bar stools				plants			
			glass fridge				pasteries			
Visual + Auditory	27						espresso frame			7
							cookie jar			
		4	5	2	2	1	7			
	28		tables	pendant lamps	wood floor	suspended ceiling	"good vibes only"			16
			chairs	wall lamps		spacious	coffee jar			
			service counter				sugar jar			
							plants			
							pasteries			
Visual + Auditory	29						espresso frame			8
							donut			
							beverage varieties			
		3	2	1	2	8				
	30		tables			tables and chairs at center	"good vibes only"	4 chairs at center		22
			chairs			text on left wall	pasteries	5 bar stools		
			service counter			banquette seating location	menu	2 tables at center		
			bar stools				beverage varieties	3 backless stools		
			backless stools					4 tables		
Visual + Auditory	31		banquette seating			menus above counter		6 chairs		6
						bar on the right				
						backless stools on the left				
	32									6

Figure 7b. Content Analysis Matrix Layout: Participant Responses of the Visual and Auditory Group

G.	#	Colors	Furniture	Fixtures	Materials/Forms	Spatial Remarks	Accessories	Numerical Values	Sensory Stimuli	Total
Visual + Auditory	27	green chairs white service counter brown elements white ceiling pink donuts yellow light brown table legs red cake	tables chairs service counter glass fridge counter cabinets	pendant lamps	-	glass fridge location panels on walls coffee cups location	oat jar coffee jar espresso frame coffee cups cake donut cupcake	2 coffee cups	-	25
		8	5	1		3	7	1		
	28	green chairs brown chairs white tables brown banquette seating	tables chairs bar stools banquette seating	pendant lamps wall lamps	-	jar location plants from ceiling suspended ceiling lamps on back wall	oat jar coffee jar sugar jar plants coffee machine pasteries cookie jar donut	9 pendant lamps 4 tables 14 stools/chairs 5 jars 1 banquette	-	27
		4	4	2		4	8	5		
	29	green plants	tables chairs glass fridge	pendant lamps sink and faucet	-	plants from ceiling pendants above service counter chairs and tables at the back corner	plants coffee machine pasteries cake	4 chairs at center 2 tables at center 2 chairs at the back 2 tables at the back	-	17
		1	3	2		3	4	4		
	30	green, brown, cream color scheme	tables chairs bar stools backless stools banquette seating shelves	-	wood floor	jar location tables and chairs at center chairs and tables at the back corner	"good vibes only" coffee jar pasteries espresso frame	4 chairs at center 5 bar stools 2 tables at center 3 types of chairs 5 jars 2 chairs at the back 1 banquette 2 tables at the back	-	23
		1	6		1	3	4	8		
	31	green, brown, cream color scheme	tables chairs bar stools backless stools	pendant lamps wall lamps	-	wall niches	"good vibes only" oat jar coffee jar sugar jar plants price tags pasteries "coffee" text coffee cups	5 bar stools 3 backless stools 3 coffee jars 1 sugar jar 1 oat jar 2 coffee cups 6 chairs	-	24
		1	4	2		1	9	7		
	32	green, brown, cream color scheme	tables chairs service counter bar stools backless stools banquette seating working counter shelves	pendant lamps	-	jar location niche location tables and chairs at center pendants above service counter text on left wall left wall counter banquette seating location backless stools on the left plants inside niches	"good vibes only" coffee jar sugar jar plants coffee machine pasteries	3 backless stools 3 niche plants	-	30
		1	8	1		9	9	2		

Figure 7b. (cont'd)

G.	#	Colors	Furniture	Fixtures	Materials/Forms	Spatial Remarks	Accessories	Numerical Values	Sensory Stimuli	Total
Visual + Auditory	33	green chairs brown chairs	tables chairs backless stools	pendant lamps wall lamps	-	tables and chairs at center lamps on back wall	coffee jar menu espresso frame beverage varieties	6 pendants 2 menus 3 backless stools 14 stools/chairs	-	17
			2	3		2	4	4		
	34	-	tables chairs service counter bar stools banquette seating working counter	-	-	tables and chairs at center left wall counter banquette seating location menus above counter bar on the right	pasteries menu beverage varieties	4 chairs at center 5 bar stools 2 chairs at the back 1 banquette	-	18
			6			5	3	4		
	35	green plants green chairs brown chairs brown elements	chairs	pendant lamps wall lamps	-	plants from ceiling text on left wall frame location lamps on back wall plants inside niches	"good vibes only" plants menu beverage varieties	6 pendants	-	17
			4	1		5	4	1		
	36	green chairs brown banquette seating brown suspended ceiling pink donuts	tables chairs service counter bar stools backless stools glass fridge shelves	pendant lamps wall lamps	glass	jar location tables and chairs at center text on left wall suspended ceiling banquette seating location bar on the right backless stools on the left lamps on back wall	"good vibes only" plants price tags pasteries menu donut beverage varieties cups and plates	5 bar stools 6 pendants 3 wall lamps 1 banquette 2 tables at the back	-	35
			4	7		1	8	5		
	37	green chairs brown chairs green, brown, cream color scheme pink donuts red cake	tables chairs service counter bar stools backless stools	sink and faucet	-	tables and chairs at center frame location bar on the right chairs and tables at the back corner	"good vibes only" coffee machine pasteries menu espresso frame coffee cups cake donut beverage varieties cups and plates coffee grinding machine	5 bar stools 2 tables at center 3 backless stools 4 tables 2 coffee cups 9 types of pasteries 2 tables at the back	-	33
			5	5		4	11	7		
	38	green chairs brown chairs	tables chairs service counter bar stools glass fridge shelves	pendant lamps wall lamps sink and faucet	-	jar location tables and chairs at center plants from ceiling pendants above service counter backless stools on the left lamps on back wall	"good vibes only" coffee jar sugar jar plants coffee machine pasteries donut coffee and desert plate coffee grinding machine	4 chairs at center 5 bar stools 2 tables at center	-	29
			2	6		6	9	3		

Figure 7b. (cont'd)

G.	#	Colors	Furniture	Fixtures	Materials/Forms	Spatial Remarks	Accessories	Numerical Values	Sensory Stimuli	Total
Visual + Olfactory	39	warm tones	tables chairs bar stools	-	-	plants from ceiling harmonious	coffee jar plants menu cup	-	-	10
	40	-	tables chairs bar stools	-	-	-	"good vibes only" coffee jar coffee machine price tags pasteries menu espresso frame cup	-	-	11
	41	green plants	tables chairs service counter bar stools backless stools banquette seating glass fridge shelves	pendant lamps wall lamps	-	jar location tables and chairs at center plants from ceiling pendants above service counter banquette seating location menus above counter	"good vibes only" oat jar coffee jar sugar jar plants coffee machine pasteries menu cookie jar 1 sugar jar 1 oat jar 3 wall lamps 14 chairs	4 chairs at center 5 bar stools 6 pendants 2 tables at center 2 menus 3 backless stools 4 tables 5 jars 3 coffee jars 1 oat jar 3 wall lamps 14 chairs	-	39
	42	white service counter	tables chairs service counter bar stools backless stools glass fridge	-	wood floor	-	coffee jar plants coffee machine pasteries espresso frame	4 chairs at center 5 bar stools 2 tables at center	-	16
	43	pastel colors	tables chairs service counter bar stools backless stools glass fridge	pendant lamps	-	tables and chairs at center plants from ceiling text on left wall spacious bar on the right backless stools on the left	"good vibes only" coffee jar plants coffee machine pasteries "coffee" text	4 chairs at center 5 bar stools 2 tables at center 3 backless stools 14 chairs	-	25
	44	-	tables chairs bar stools glass fridge shelves	pendant lamps wall lamps spotlights	textured wall paint wooden panels glass	jar location menus above counter	coffee jar pasteries menu cake donut	-	-	18
	45	green chairs white table brown elements light brown wood dark brown wood	tables chairs service counter bar stools glass fridge	pendant lamps wall lamps led lights	wood furniture wooden panels glass gold lamps marble tables upholstered chairs	plants from ceiling text on left wall panels on walls	"good vibes only" plants coffee machine pasteries	-	coffee smell	27
	46	green plants green, brown, cream color scheme	tables chairs service counter bar stools glass fridge	pendant lamps wall lamps led lights	-	plants from ceiling pendants above service counter text on left wall menus above counter lamps on back wall	"good vibes only" plants pasteries menu beverage varieties	3 types of chairs	-	21

Figure 7c. Content Analysis Matrix Layout: Participant Responses of the Visual and Olfactory Group

G.	#	Colors	Furniture	Fixtures	Materials/Forms	Spatial Remarks	Accessories	Numerical Values	Sensory Stimuli	Total			
Visual + Olfactory	47	-	tables	sink and faucet		jar location	"good vibes only"	2 coffee cups	-	17			
			chairs										
			bar stools										
			shelves										
48	-	tables	pendant lamps		plants from ceiling	"good vibes only"	9 pendant lamps	-	28				
		chairs	wall lamps			coffee jar	5 bar stools						
		bar stools				sugar jar	3 backless stools						
		backless stools				plants	4 tables						
						coffee machine	3 coffee jars						
						coffee cups	1 sugar jar						
							3 wall lamps						
							2 coffee cups						
							6 chairs						
							1 coffee machine						
		3 niche plants											
49	green plants green chairs brown suspended ceiling pink donuts yellow light	tables	pendant lamps	upholstered chairs	plants from ceiling	"good vibes only"	3 coffee jars	-	29				
		chairs	led lights			coffee jar	2 cookie jars						
		service counter				plants							
		bar stools				pasteries							
		glass fridge				"coffee" text							
						menu							
						espresso frame							
						cookie jar							
						donut							
50	white service counter brown banquette seating	tables	pendant lamps	wood furniture	jar location	coffee jar	6 pendants	-	26				
		chairs	wooden panels	plants from ceiling	plants	2 menus							
		service counter	upholstered chairs	banquette seating location	pasteries	5 jars							
		bar stools		globe lamps	menu								
		banquette seating		bar on the right	beverage varieties								
		glass fridge											
		51	-	tables	pendant lamps	-	-			"good vibes only"	-	-	14
				chairs						oat jar			
				service counter						coffee jar			
				bar stools						sugar jar			
	pasteries												
	menu												
	espresso frame												
	cookie jar												
	donut												

Figure 7c. (cont'd)

G.	#	Colors	Furniture	Fixtures	Materials/Forms	Spatial Remarks	Accessories	Numerical Values	Sensory Stimuli	Total
Visual + Olfactory	52	cream tones	tables	pendant lamps	wood floor	-	coffee jar	-	-	14
			chairs		glass		sugar jar			
			service counter				plants			
							menu			
							espresso frame			
							cookie jar			
							beverage varieties			
			1	3	1	2	7			
	53	green plants	tables	-	-	tables and chairs at center	oat jar	2 tables at center	-	19
		white tables	chairs			frame location	coffee jar	1 coffee machine		
			service counter			spacious	sugar jar			
			bar stools				plants			
							coffee machine			
							pasteries			
							espresso frame			
			2	4		3	8	2		
	54	green chairs	tables	-	-	jar location	"good vibes only"	4 chairs at center	-	27
			chairs			tables and chairs at center	oat jar	5 bar stools		
			service counter				coffee jar	2 tables at center		
			bar stools			plants from ceiling	sugar jar	3 coffee jars		
			backless stools			text on left wall	plants			
			banquette seating			banquette seating location	pasteries			
							menu			
							beverage varieties			
						menus above counter				
						bar on the right				
						backless stools on the left				
			1	6		8	8	4		
	55	green plants	tables	led lights	wood furniture	tables and chairs at center	"good vibes only"	4 chairs at center	coffee smell	26
		white tables	chairs		wood suspended ceiling	suspended ceiling	plants	5 bar stools		
		pastel colors	service counter		circular tables	frame location	coffee machine	2 tables at center		
			bar stools			glass fridge location	pasteries			
			shelves			bar on the right	espresso frame			
			3	5	1	3	5	3		
	56		tables	pendant lamps	-	jar location	"good vibes only"	4 chairs at center	-	33
			chairs	wall lamps		tables and chairs at center	coffee jar	5 bar stools		
			service counter			plants from ceiling	plants	2 tables at center		
			bar stools				pasteries	3 backless stools		
			backless stools			pendants above service counter	menu	2 cookie jars		
			banquette seating			text on left wall	cookie jar	2 chairs at the back		
			working counter			left wall counter	beverage varieties	9 types of pasteries		
			shelves			banquette seating location				
						backless stools on the left				
						lamps on back wall				
			8	2		9	7	7		
	57		tables	pendant lamps	-	pendants above service counter	coffee machine	4 chairs at center	-	16
			chairs	wall lamps		bar on the right	pasteries	5 bar stools		
			service counter				espresso frame	6 pendants		
			bar stools				beverage varieties	2 tables at center		
			4	2		2	4	4		

Figure 7c. (cont'd)

G.	#	Colors	Furniture	Fixtures	Materials/Forms	Spatial Remarks	Accessories	Numerical Values	Sensory Stimuli	Total
Visual + Auditory + Olfactory	58	green, brown, cream color scheme	tables chairs service counter bar stools backless stools glass fridge	wall lamps sink and faucet	wood furniture	tables and chairs at center plants from ceiling text on left wall frame location glass fridge location backless stools on the left lamps on back wall	"good vibes only" coffee machine pasteries espresso frame	4 chairs at center 5 bar stools 2 tables at center	-	24
	59	-	chairs service counter bar stools	-	-	spacious bar on the right	coffee jar sugar jar pasteries menu espresso frame beverage varieties	5 bar stools 14 stools/chairs	-	13
	60	green chairs	tables chairs service counter bar stools	pendant lamps wall lamps	-	-	coffee jar sugar jar pasteries espresso frame cookie jar	5 bar stools 14 stools/chairs	-	14
	61	green plants green chairs white service counter white tables	tables chairs service counter bar stools banquette seating glass fridge	pendant lamps wall lamps	wood floor marble counter wooden panels glass marble tables gold fridge details	pendants above service counter text on left wall bar on the right lamps on back wall panels on counter pendants above working counter	"good vibes only" plants coffee machine pasteries cookie jar	5 bar stools 6 pendants 3 wall lamps 6 chairs 3 pendants	-	34
	62	green, brown, cream color scheme green chairs brown chairs white service counter white tables brown table legs white "good vibes only" text white "coffee" text	tables chairs service counter bar stools glass fridge	pendant lamps wall lamps led lights	wood floor wooden panels glass circular tables curvilinear walls	jar location tables and chairs at center pendants above service counter text on left wall glass fridge location bar on the right lamps on back wall "coffee" text location	"good vibes only" oat jar coffee jar sugar jar coffee machine price tags pasteries "coffee" text	4 chairs at center 5 bar stools 6 pendants 2 tables at center 5 jars 3 wall lamps	-	43
	63	green plants	tables chairs service counter bar stools banquette seating glass fridge working counter shelves	pendant lamps wall lamps sink and faucet	glass globe lamps	jar location tables and chairs at center plants from ceiling pendants above service counter banquette seating location bar on the right lamps on back wall "coffee" text location sink and faucet location	coffee jar plants pasteries "coffee" text	4 chairs at center 6 pendants 2 tables at center 3 wall lamps 2 chairs at the back	-	32

Figure 7d. Content Analysis Matrix Layout: Participant Responses of the Visual, Auditory, and Olfactory Group

G.	#	Colors	Furniture	Fixtures	Materials/Forms	Spatial Remarks	Accessories	Numerical Values	Sensory Stimuli	Total
Visual + Auditory + Olfactory	64	green chairs	tables	-	wood furniture	-	"good vibes only"	4 chairs at center	-	25
		white tables	chairs		marble tables		plants	2 tables at center		
		brown elements	service counter		upholstered chairs		pasteries	3 backless stools		
			backless stools				menu	2 chairs at the back		
			banquette seating				cake	1 banquette		
			glass fridge				donut			
							beverage varieties			
							cupcake			
		3	6		3		8	5		
	65	-	tables	pendant lamps	-	tables and chairs at center	"good vibes only"	-	-	21
			chairs			plants from ceiling	plants			
			service counter			pasteries				
			bar stools			espresso frame				
			backless stools			pendants above service counter				
			working counter			text on left wall				
						suspended ceiling				
						left wall counter				
						glass fridge location				
						menus above counter				
						bar on the right				
		backless stools on the left								
	6	1	10	4						
	66	green plants	tables	pendant lamps	wood furniture	tables and chairs at center	coffee jar	4 chairs at center	-	27
			chairs	wall lamps	marble tables	plants from ceiling	plants	5 bar stools		
			service counter	upholstered chairs	frame location	coffee machine	2 tables at center			
			bar stools		menu	2 chairs at the back				
			banquette seating		espresso frame	1 banquette				
					bar on the right					
				lamps on back wall						
		1	5	2	3	6	5	5		
	67	green plants	tables	-	-	tables and chairs at center	coffee jar	4 chairs at center	-	22
		pink donuts	chairs			glass fridge location	coffee machine	5 bar stools		
			service counter			spacious	price tags	2 tables at center		
			bar stools			harmonious	pasteries	6 pink donuts		
			glass fridge				espresso frame			
						coffee cups				
						donut				
	2	5	4	7	4					
	68	green plants	tables	pendant lamps	wooden panels	tables and chairs at center	"good vibes only"	4 chairs at center	-	31
		green chairs	chairs	wall lamps		plants from ceiling	plants	2 tables at center		
		green, brown, cream color scheme	service counter			pendants above service counter	coffee machine	1 coffee machine		
			bar stools			pasteries	2 chairs at the back			
		white service counter				text on left wall	cookie jar	2 tables at the back		
						suspended ceiling	coffee cups			
						spacious	donut			
						bar on the right				
			chairs and tables at the back corner							
		4	4	2		1	8	7		
	69	green plants	tables	pendant lamps	-	tables and chairs at center	"good vibes only"	9 pendant lamps	-	31
		green chairs	chairs			plants from ceiling	price tags	4 chairs at center		
		white tables	service counter			pasteries	2 tables at center			
			bar stools			menu	3 backless stools			
			backless stools			cake	2 chairs at the back			
			working counter			beverage varieties	2 tables at the back			
			cupcake							
		chairs and tables at the back corner	cups and plates							
			coffee and desert plate							
3		6	1			6	9	6		

Figure 7d. (cont'd)

G.	#	Colors	Furniture	Fixtures	Materials/Forms	Spatial Remarks	Accessories	Numerical Values	Sensory Stimuli	Total
Visual + Auditory + Olfactory	70	green, brown, cream color scheme	tables chairs	pendant lamps sink and faucet	marble counter wooden panels	jar location niche location	"good vibes only" coffee jar	3 large niches 4 chairs at center	-	50
		white service counter	service counter bar stools		half wood half marble counter	tables and chairs at center	sugar jar	5 bar stools		
		white tables	backless stools			plants from ceiling	coffee machine	2 tables at center		
			banquette seating shelves			pendants above service counter	pasteries	3 backless stools		
						text on left wall	cookie jar	3 coffee jars		
						wall niches	coffee cups	1 sugar jar		
							cake	3 pendants		
						banquette seating location	coffee and desert plate	2 chairs at the back		
								1 banquette		
						backless stools on the left		2 tables at the back		
						panels on counter				
						coffee cups location				
						sink and faucet location				
	chairs and tables at the back corner									
			3	7	2	3	13	10	12	
71	green chairs	tables	pendant lamps	globe lamps	plants from ceiling	coffee jar	5 bar stools	-	34	
	green, brown, cream color scheme	chairs	led lights		menus above counter bar on the right chairs and tables at the back corner led light under counter	plants	5 jars			
	yellow light	service counter	coffee machine			2 coffee cups				
	white led light	bar stools	price tags			2 chairs at the back				
	red, white, and blue cupcake	shelves	pasteries			2 tables at the back				
			menu							
			coffee cups							
			cake							
			beverage varieties							
			cupcake							
		coffee grinding machine								
		5	5	2	1	5	11	5		
72	green chairs	tables	-	wood floor	tables and chairs at center	"good vibes only"	-	background noise coffee smell	32	
	brown chairs	chairs		glass	text on left wall	coffee jar				
	light brown wood	service counter			frame location	sugar jar				
	pink donuts	bar stools			coffee machine	coffee machine				
	red cake	glass fridge			pasteries	pasteries				
	white "good vibes only" text				"coffee" text	"coffee" text				
				menu	menu					
				espresso frame	espresso frame					
				cake	cake					
	black menu text				donut	donut				
beverage varieties			beverage varieties							
		coffee grinding machine	coffee grinding machine							
		7	5		2	4	12	2		
73	green chairs	tables	wall lamps	-	jar location	"good vibes only"	4 chairs at center	-	31	
		chairs			tables and chairs at center	plants	5 bar stools			
		service counter			pasteries	2 tables at center				
		bar stools			menu	2 chairs at the back				
		banquette seating			cookie jar	1 banquette				
		glass fridge			cake	2 tables at the back				
					donut					
					menus above counter					
					bar on the right					
					lamps on back wall					
chairs and tables at the back corner										
		1	6	1		10	7	6		

Figure 7d. (cont'd)

G.	#	Colors	Furniture	Fixtures	Materials/Forms	Spatial Remarks	Accessories	Numerical Values	Sensory Stimuli	Total
Visual + Auditory + Olfactory	74	green chairs	tables	pendant lamps		tables and chairs at center	"good vibes only"	9 pendant lamps	background noise	41
		cream tones	chairs	wall lamps		text on left wall	coffee jar	4 chairs at center	coffee smell	
		red cake	service counter	led lights			coffee machine	5 bar stools		
			bar stools			banquette seating location	price tags	2 tables at center		
			backless stools				pasteries	3 backless stools		
			banquette seating			menus above counter	menu	14 stools/chairs		
			glass fridge			bar on the right	cake	6 chairs		
						backless stools on the left	donut	2 chairs at the back		
						lamps on back wall	beverage varieties	2 tables at the back		
						chairs and tables at the back corner				
		3	7	3		8	9	9	2	
Visual + Auditory + Olfactory	75	green chairs	tables	pendant lamps	wood floor	tables and chairs at center	"good vibes only"	5 bar stools		57
		green, brown, cream color scheme	chairs	wall lamps	marble counter	center	coffee jar	2 tables at center		
			service counter	led lights	glass	plants from ceiling	plants	2 menus		
		white service counter	bar stools		upholstered chairs	text on left wall	coffee machine	3 backless stools		
		white tables	backless stools		circular tables	suspended ceiling	price tags	5 jars		
			banquette seating		banquette seating location		pasteries	3 wall lamps		
		brown banquette seating	glass fridge		gold fridge details		menu	3 niche plants		
		light brown wood				menus above counter	espresso frame	9 types of pasteries		
		brown suspended ceiling				bar on the right	cookie jar	2 tables at the back		
		red cake				backless stools on the left	coffee and desert plate			
		green espresso frame				chairs and tables at the back corner				
		white menu				led light under counter				
						plants inside niches				
		10	7	3	6	11	11	9		
	76	green plants	tables	pendant lamps	wood floor	jar location	"good vibes only"	4 chairs at center		50
		green chairs	chairs	wall lamps	marble counter	niche location	coffee jar	5 bar stools		
		green, brown, cream color scheme	service counter	sink and faucet	glass	tables and chairs at center	plants	6 pendants		
			bar stools			plants from ceiling	coffee machine	2 tables at center		
		black and white text on jars	backless stools				pasteries	3 backless stools		
		gray coffee machine	glass fridge			pendants above service counter	espresso frame	5 jars		
						text on left wall	cookie jar	3 coffee jars		
						frame location	coffee cups	3 wall lamps		
						glass fridge location		1 coffee machine		
						bar on the right		2 cookie jars		
						backless stools on the left		2 chairs at the back		
						lamps on back wall		2 tables at the back		
						sink and faucet location				
						plants inside niches				
		5	6	3	3	13	8	12		

Figure 7d. (cont'd)

G.	#	Colors	Furniture	Fixtures	Materials/Forms	Spatial Remarks	Accessories	Numerical Values	Sensory Stimuli	Total
ALL LISTED ITEMS		green plants	tables	pendant lamps	wood floor	jar location	"good vibes only"	9 pendant lamps	background noise	137
		green chairs	chairs	wall lamps	wood furniture	niche location	oat jar	3 large niches	clinking of plates and forks	
		brown chairs	service counter	spotlights	marble counter	tables and chairs at center	coffee jar	4 chairs at center	coffee smell	
		green, brown, cream color scheme	bar stools	sink and faucet	textured wall paint	plants from ceiling	sugar jar	5 bar stools		
			backless stools	led lights			plants	6 pendants		
		white service counter	banquette seating		wooden panels	pendants above service counter	coffee machine	2 tables at center		
			glass fridge		glass		price tags	2 menus		
		white tables	working counter		gold lamps	text on left wall	pasteries	3 backless stools		
		brown elements	counter cabinets		marble tables	suspended ceiling	"coffee" text	3 types of chairs		
		white ceiling	shelves			left wall counter	menu	5 spotlights		
		brown banquette seating			upholstered chairs	wall niches	espresso frame	4 tables		
		warm tones			wood suspended ceiling	frame location	cookie jar	14 stools/chairs		
		pastel colors			globe lamps	glass fridge location	coffee cups	12 lamp fixtures		
		light brown wood			circular tables	spacious	cake	5 jars		
		dark brown wood			gold fridge details	harmonious	donut	3 coffee jars		
		brown suspended ceiling			curvilinear walls	banquette seating location	beverage varieties	1 sugar jar		
		pink donuts			half wood half marble counter		cupcake	1 oat jar		
		yellow light				menus above counter	cups and plates	3 wall lamps		
		cream tones				bar on the right	coffee and desert plate	2 coffee cups		
		brown table legs						6 chairs		
		red cake				backless stools on the left	coffee grinding machine	1 coffee machine		
		white "good vibes only" text				panels on walls		3 niche plants		
		white "coffee" text				lamps on back wall		2 cookie jars		
		white led light				panels on counter		3 pendants		
		red, white, and blue cupcake				pendants above working counter		2 chairs at the back		
		black menu text				coffee cups location		1 banquette		
		green espresso frame				"coffee" text location		9 types of pasteries		
		white menu background				sink and faucet location		6 pink donuts		
		black and white text on jars				chairs and tables at the back corner		2 tables at the back		
		gray coffee machine				led light under counter				
						plants inside niches				
		28	10	5	15	27	20	29	3	

Figure 7e. Content Analysis Matrix Layout: All Listed Distinct Items

APPENDIX H. Memory Retention Means Graphs

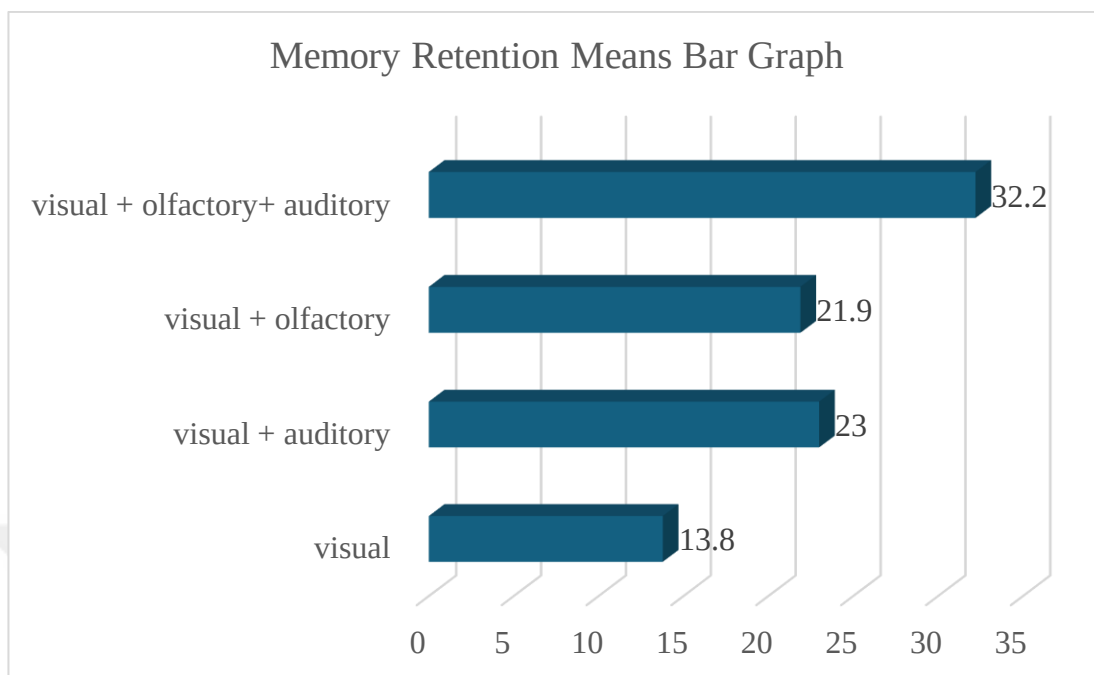


Figure 8a. Memory Retention Means Bar Graph

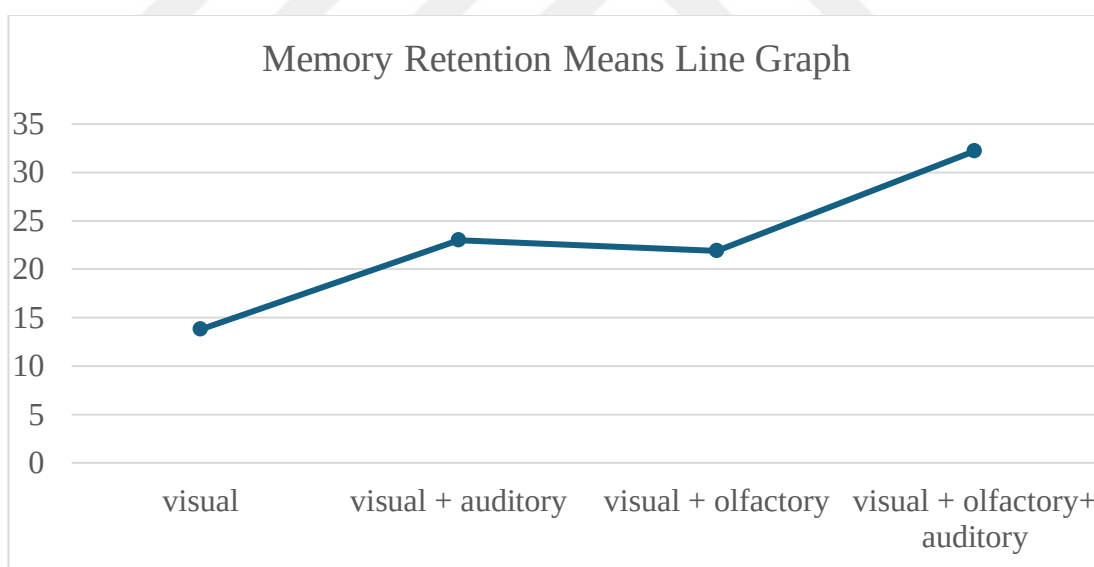


Figure 8b. Memory Retention Means Line Graph