Working Memory Strategies as a Tool for Regulating the Cognitive Process and Making Effective Design Decisions

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Abstract

Memory is crucial in decision-making, as its limitations drive the adoption of strategies to reduce cognitive load, particularly when processing vast information. It progresses through stages, from sensory reception to classification in working memory, forming the basis for decisions, in architectural design, decisions aligning with requirements, necessitating an understanding of memory and perception. However, many designers focus only on visual perception, causing imbalances, Therefore, the research problem highlights designers' lack of awareness of the three perceptual dimensions, essential for integrating design with functional and psychological needs, And The study hypothesizes that controlling sensory, emotional, and symbolic perception can enhance design decisions. It explores memory mechanisms to develop solutions by managing environmental stimuli, A case study on Alexandria's Jewelry Palace Museum, including a questionnaire, revealed dominant visual attraction to interiors over exhibits, disrupting function, The study underscores integrating all perceptual dimensions for coherent spaces and informed design decisions.

1. INTRODUCTION

Architectural design is essentially a mental process based on the continuous reception, evaluation, and organization of environmental information to support design decision-making. This process is strongly connected to human perception and memory, particularly working memory, which serves as a central mechanism that enables designers to process sensory inputs, temporarily store information, and generate spatial solutions that meet contextual and user needs (Baddeley, 1974) (Engle, 2010) , Working memory reduces cognitive burden by using specific mental strategies such as repetition and information grouping, which improve the retention and retrieval of data under complex design conditions.

However, in architectural practice, design decisions tend to rely heavily on visual perception, often neglecting the broader perceptual dimensions such as emotional and symbolic perception. This imbalance can result in spaces that are visually appealing but may lack functional clarity or psychological comfort , As indicated by Rapoport (1990) and Pallasmaa (1994) , perception is a process involving multiple senses and is guided by meaning, and thus the quality of architectural spaces improves when emotional and symbolic values are considered alongside visual elements. (Pallasmaa J. , 1994) (Rapoport, Amos, 1990)

Recent research in architectural psychology and cognitive neuroscience highlights the importance of a multisensory design approach , where perception is formed not only by visual input but also by sounds, smells, and tactile sensations (Mfon, 2023) Additionally, symbolic perception plays a role in forming spatial identity, cultural association, and memory retention (Wilson, M, 2018) , Working memory contributes to this process by temporarily organizing perceptual inputs into meaningful units, allowing the architect to make fast and effective design decisions (Al-Qaymaqji, 2018) .

Accordingly, the present study focuses on the relationship between memory—especially working memory—and the regulation of perception in architectural design. It aims to test the hypothesis that managing the sensory, emotional, and symbolic dimensions of perception using memory-based strategies can improve design outcomes. This will be examined through a case study of the Jewelry Palace Museum in Alexandria, supported by a questionnaire to explore how perceptual imbalance can impact the intended function of exhibition spaces.

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2. RESEARCH PROBLEM

The research problem lies in the insufficient awareness among designers regarding the perceptual process and its three dimensions, which are essential for making design decisions that achieve integration between the functional and psychological aspects of architectural design.

3. RESEARCH HYPOTHESIS

This research paper hypothesizes that controlling the dimensions of perception through studying sensory, emotional, and symbolic processes and making influential changes to them can enable designers to make sound design decisions that align with architectural requirements.

4. RESEARCH OBJECTIVE

The research aims to explore the components of memory and its operational strategies to develop design solutions based on controlling environmental stimuli surrounding individuals within space during the perceptual process. This contributes to making design decisions that achieve integration with users' functional and psychological requirements.

5. RESEARCH METHODOLOGY

The study adopts a descriptive (survey-based), analytical, and applied approach by examining various concepts, analyzing architectural models, and conducting an applied study on the Jewelry Palace Museum in Alexandria.

6. MEMORY COMPONENTS

Memory plays a fundamental role in decision-making, as many cognitive psychologists believe that its limited capacity drives individuals to adopt various cognitive strategies to reduce its burden, especially when dealing with large amounts of information that exceed the working memory's ability to process and make decisions accordingly , Human memory is one of the most significant mental abilities, as it integrates separate moments into a coherent context, linking individuals to the past and guiding them toward the future (Turkington, 2004). Most cognitive psychologists agree that memory consists of three main systems:

- **Sensory Memory**: Receives initial information from the environment through the senses.
- **Working Memory**: Also known as short-term memory, it temporarily processes information for decision-making.
- **Long-Term Memory**: Stores information for extended periods, allowing retrieval when needed.

6.1. *Working Memory and Strategies for Its Enhancement (Short-Term Memory - STM)*

Working memory has received significant attention from researchers due to its central role in information processing. Engle (2010) defines it as a dual-component system that includes temporary storage and representation of information (Engle, 2010), in addition to directing and executing attention. It serves as an intermediary station that receives information from sensory memory, retaining it for a short duration of approximately 10-18 seconds, which is why it is also referred to as short-term memory. Figure (1)

This type of memory has several key characteristics, the most notable being that it only retains information that captures attention, in addition to its limited capacity compared to long-term memory (Baddeley, 1974).
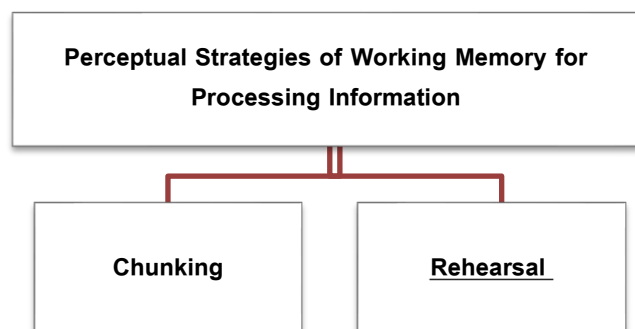
Figure (1) Perceptual Strategies of Working Memory - Source: The Researcher

Psychometric studies indicate that information retention in short-term memory can be enhanced through two main perceptual strategies (Thorne, 2001):

1. Rehearsal:
   This involves the overt or written repetition of information to be stored, which helps organize it and give it meaning, making retrieval easier later.

2. Chunking:
   This strategy increases memory capacity from about 7 units to 79 units by grouping information into meaningful cognitive chunks according to a specific pattern (Miller, 1956). For example, instead of memorizing the number (6158972) as separate units, it can be divided into two groups (615 - 8972), making it easier to recall. Chunking often takes a visual form, which is easier to remember compared to rehearsal, which relies more on verbal or written representation of information (Al- (Al-Qaymaqji, 2018).

6.1.1. Components of Working Memory

As defined by Baddeley and Hitch (Baddeley, 1974), working memory consists of three main components:

- Central Executive
- Phonological Loop
- Visuospatial Sketchpad and Attention Control

When information moves from sensory memory to working memory, it undergoes the process of attention, which involves focusing awareness on a specific stimulus while ignoring others until it is processed within working memory. Figure (2)

6.2. Sensory Memory

Sensory memory is the initial storage for information received through the senses, directly connecting individuals to their external environment. This memory retains information for a brief period ranging from ¼ to ½ second without being influenced by attention. It encodes data based on the nature of the stimulus, whether visual, auditory, or sensory, allowing it to transfer to working memory when needed. Sensory perception will be discussed in greater detail later (Neisser, U, 1967) (Atkinson, R. C., & Shiffrin, R. M, 1968) .
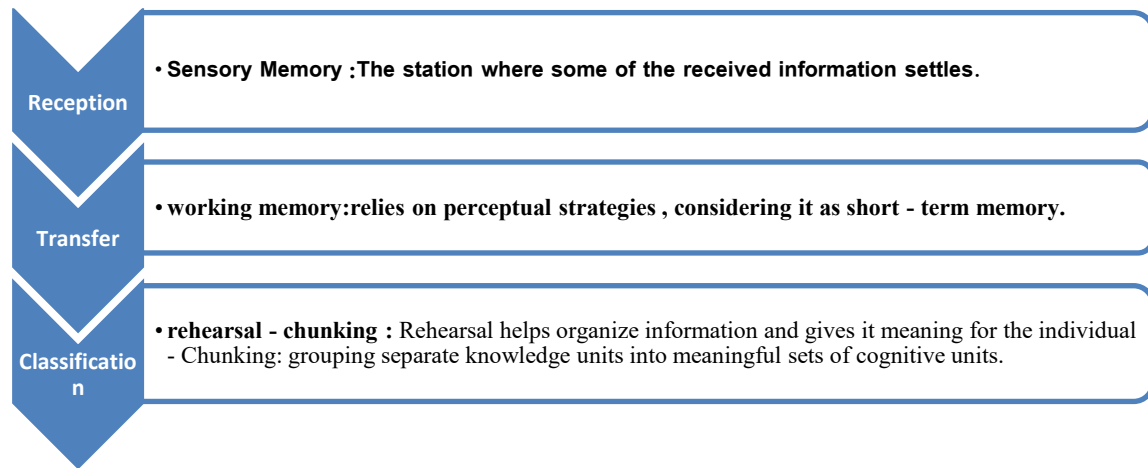
6.3. Long-Term Memory (LTM)

Long-term memory is the final repository for memories and experiences, where information is stored permanently without fading. However, retrieval may be challenging due to interference between pieces of information or the lack of appropriate cues. In contrast, forgetting in working memory (WM) is attributed to neglect or inattention, where information is lost within 10-18 seconds if it is not rehearsed or reinforced (Cherniak, 1983).

Long-term memory is divided into (Al-Omar, Badr Omar, 2023):

- **Event memory:** Stores details of events as they occurred.
- **Semantic Memory:** Retains general concepts of subjects without precise details.
- **Procedural Memory:** Involves remembering how to perform tasks.

6.4. Differences Between Long-Term Memory and Working Memory in Architectural Design

- **Long-term memory** relies on the designer's experiences related to their cultural background, knowledge, and environment, forming a cumulative knowledge base.
- **Short-term memory**, on the other hand, receives information through direct sensory perception, making it more crucial for designers during the design process, as it depends on **rehearsal** and **chunking** strategies to process incoming environmental information.

Reception

• **Sensory Memory :The station where some of the received information settles.**

Transfer

• **working memory:relies on perceptual strategies , considering it as short - term memory.**

Classification

• **rehearsal - chunking :** Rehearsal helps organize information and gives it meaning for the individual - Chunking: grouping separate knowledge units into meaningful sets of cognitive units.

Figure (2): The process of transferring information and objects from the surrounding environment to memory - Source: Researcher

From the above, we conclude that working memory plays a fundamental role in designing architectural spaces, as it processes information received from sensory memory using specialized cognitive strategies. Therefore, it is essential to study sensory perception as the first step in receiving information, which later transfers to working memory for making effective design decisions.

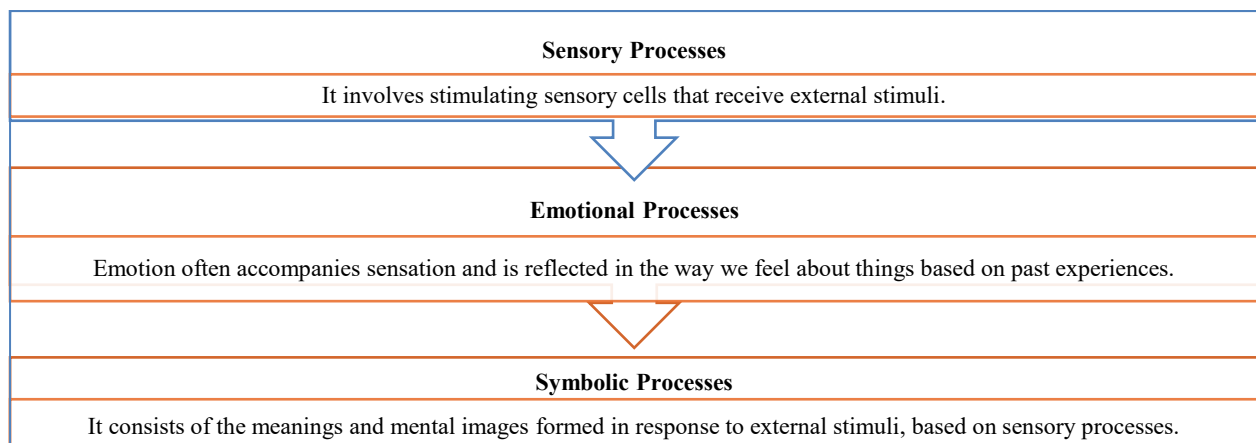## 7. THE CONCEPT OF THE PERCEPTUAL PROCESS

Perception is the process of interpreting sensory stimuli based on experience and transforming them into mental representations, where neural impulses are assigned specific meanings. Perception relies on awareness and attention and includes two main dimensions:

- **Sensory Dimension:** Related to direct sensation.
- **Cognitive Dimension:** Includes thinking and memory processes (Al-Nafs, Walid Al-Abd, 2022)

7.1. Factors Influencing the Perceptual Process

- **Personal Factors:** Include mental readiness and attention, as the level of focus affects the accuracy of perception.
- **Physiological and Psychological Needs:** The failure to meet basic needs such as food and security may weaken perception due to stress.
- **Mood and Emotional State:** An individual's perception of the world changes according to their emotional state; for example, sadness makes the world seem gloomy, while happiness presents a brighter image.
- **Values and Interests:** Individuals tend to perceive things that align with their interests more easily than those that conflict with them (Taha, 2000).

7.1.1. *Dimensions of the Perceptual Process (Al-Nafs, Walid Al-Abd, 2022)*:

Sensory Processes
It involves stimulating sensory cells that receive external stimuli.
Emotional Processes
Emotion often accompanies sensation and is reflected in the way we feel about things based on past experiences.
Symbolic Processes
It consists of the meanings and mental images formed in response to external stimuli, based on sensory processes.

Figure (3) Dimensions of the Perceptual Process – Source: The Researcher

7.1.1.1. Sensory Processes:
Sensory Perception in Architectural Design

Visual Perception

Visual perception relies on sight to understand the surrounding environment. Architectural designers have primarily focused on studying this type of perception due to its critical role in comprehending architectural spaces (Tai Hollingsbee, 2016), The eye plays a vital role in visual perception by capturing scene details based on the viewing angle, distance, and eye movement, distinguishing it from a camera, which merely captures a light-based image (Al-Harith, Abdel Hamid Hassan, 2007).

Al-Harith, in his book The Psychological Language in Architecture: An Introduction to Architectural Psychology, also states that known processes of the visual system provide only a fragmented analysis of visually acquired information. To this day, a complete explanation of the visual structure formed in the brain remains elusive.

Visual perception is the dominant sense, as it provides clearer information compared to other senses, making architecture primarily understood through vision. Visual depth gives architectural elements distinct identities and helps differentiate between light and shadow. Moreover, visual perception is not merely about capturing optical images; it also involves awareness and sensory comprehension of a place from multiple perspectives.

Environmental visual perception depends on various factors such as space, distance, texture, lighting, color, and form, all of which vary based on cultural background and visual experience, leading to significant differences in perception responses (Rapoport, Amos, 1977).

Auditory Perception

According to Rapoport in Human Aspects of Urban Form, Towards a Man-Environment Approach to Urban Form and Design, hearing is the second most studied sense after vision. It is characterized by being an ambient perception that is not confined to the visual field, making it more flexible and dynamic (Rapoport, Amos, 1977).

Auditory space is non-centralized and has a dispersed nature, making it more complex to direct or control compared to visual perception (Pallamaa, 2005). Architects can manipulate sound environments by contrasting noisy and quiet areas, enhancing user awareness of space. For instance, the sudden transition from a crowded area to a quiet one can draw attention to natural elements such as the sound of water or birds (Rapoport, Amos, 1977).

Studies indicate that every building or space has its unique sound, which affects users' perception. Sounds reflect the character of a space, whether intimate or grand, welcoming or hostile (Bavister, (2018).) (Porteous, 1985). However, architectural research has largely focused on noise reduction while overlooking the positive aspects of sound, such as the effects of music and soundscapes on patient comfort in healthcare environments.

Schafer, in The Soundscape: Our Sonic Environment and the Tuning of the World, states: "Modern architects design for the deaf... Sound is only studied in architecture schools through noise reduction, insulation, and absorption." (schafer, 1977).

However, some research explores the positive effects of sound, such as incorporating natural sounds, like running water, to regulate unwanted noise (schafer, 1977).

An example of using natural sounds to mitigate noise pollution is Paley Park in New York, which provides an innovative solution to urban noise issues. In 1967, an empty lot on 53rd Street, left after the demolition of the Stork Club, was transformed into a pocket park. Designed by Zion & Breen, the space effectively isolates urban noise with a waterfall at the far end, while dense green vegetation along the walls further absorbs city noise (Corbusier, 1948).

The design of Paley Park can be analyzed as follows
- **Auditory/Design Description:**

A 6-meter-high rear waterfall continuously produces white noise, effectively masking the ambient noise of Manhattan.
- **Sensory & Functional Purpose:**

Functions as a natural sound barrier and creates an acoustically protected micro-environment in a highly urban context.
- **Psychological/User Impact:**

Promotes relaxation, reduces sensory overload, and enhances users' ability to socialize or reflect in a calm setting.
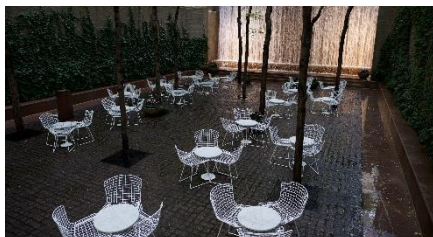
Figure4: Paley Park in New York , source : (https://www.paleypark.org/ , 2025)

Another example highlights how integrating natural soundscapes into healthcare environments can enhance user experience, The design leverages auditory perception to support emotional and physiological healing.

Healing Gardens – Legacy Emanuel Medical Center, USA
- **Auditory/Design Description:**

Incorporates natural soundscapes, including birdsong and water features, within hospital therapeutic gardens.
- **Sensory & Functional Purpose:**

Reduces stress, promotes healing, and improves physiological and emotional well-being.
- **Psychological/User Impact:**

Enhances patient comfort, lowers anxiety levels, and supports mental recovery through biophilic engagement.

Figure5 : Legacy Emanuel Medical Center, USA , source : (https://naturesacred.org/, 2025)

we can conclude that analyzing auditory phenomena can aid in designing spaces that evoke specific emotional responses by providing insights into how sound interacts with the environment and influences human emotions.

Perception by Touch: Touch is a fundamental sense in perception, especially for visually impaired individuals, as it helps recognize the characteristics of the physical environment (Al-Tawab, Yasmin Abdel, 2013). Tactile perception includes sensations of heat, cold, humidity, and texture, enhancing sensory interaction with architecture (Frampton, 1981).

Architects often ignore the tactile dimension in design, despite its importance in enhancing user experience. Richard Sennett points out that modern architecture lacks sensory interaction, creating a sense of rigidity and monotony (Sennett, 1994). In contrast, natural materials such as wood and marble enhance sensory engagement with the environment compared to modern materials that lack this quality (Pallasmaa J. , 1994) , An example of tactile integration in architecture is the TOM Museum for the Visually Impaired in Tokyo, where different materials and temperature variations were incorporated to enhance sensory experience (Sennett, 1994).

Kinetic Perception: is responsible for movement and an individual's sense of position and direction up, down, forward, and backward, It also governs balance and three dimensional spatial awareness , This perception is primarily engaged with ground surfaces, collecting information from them (Lynch K. B., 1990).

Time Perception: involves the awareness of change by perceiving synchronization or sequencing of specific events. It is a relative concept (Lynch K. , 1960).

Olfactory Perception: Scents play a crucial role in perceiving architectural spaces, directly influencing user experience , Studies confirm that negative smells leave stronger impressions than positive ones, highlighting the importance of controlling the olfactory environment within architectural spaces (Drobnick, 2006).

According to Rapoport (1977), the sense of smell is a primary perception channel influencing memory and emotional attachment to a place. (Vroon, 1994) also states that scents affect physiological processes and behavior, closely linking them to emotions and motivations. Research indicates that certain fragrances can enhance cognitive performance and reduce stress in architectural environments (Baron, 1994) (Rapoport, Amos, 1977).

In a study on the impact of pleasant fragrances on performance, Robert Baron and Jill Thomley found that such scents act as positive environmental stimuli, enhancing alertness, productivity, and cognitive task performance while reducing conflicts and direct confrontations. Additionally, strong ambient scents reinforce the primary identity of a place, transforming an otherwise unremarkable space into a distinctive environment (Baron, 1994).

Furthermore, the sense of smell often acts as a sensory trigger, evoking memories and past experiences through familiar scents (P. A. Vroon, 1997) .

Sensory Interaction in Architectural Perception: Comparing the relative importance of senses reveals that all senses are equal in their fundamental characteristics and range , The researchers pointed out that the meaning of perception can be extended to include intuition or immediate perception of information from the environment through one or more senses.

In a successful study, Malnar & Vodvarka (2004) demonstrated in Sensory Design (Malnar, J. M., & Vodvarka, F, 2004) that the range of each sense overlaps significantly with others, emphasizing that no single sense is inherently superior , They concluded that overall spatial structure emerges through sensory perception within an interactive (Malnar, 1992) , Amos Rapoport argued that an environment cannot be fully experienced as a mere perspective, photograph, or film alone due to the excessive reliance on vision and neglect of multi sensory perception (Rapoport, Amos, 1977).

Helge (1992) ranked the senses in terms of their role in attracting attention:

Vision: 70% - **Hearing:** 20% - **Smell:** 5% - **Touch:** 4% - **Taste:** 1%

This ranking applies generally, not exclusively to architecture. When applied to architectural design:

• **Vision** is represented through visual elements such as form, color, light, and space, which play a crucial role in spatial perception , Supporting evidence indicates that visual aesthetics significantly impact psychological response and overall satisfaction with architectural spaces (Hussein A. N., 2023).

• **Hearing** influences comfort and functionality, as good acoustic design enhances the usability of spaces such as concert halls, offices, and homes. Poor acoustics contribute to stress and lower productivity, emphasizing the importance of considering sound in design (Sonja Di Blasio, 2019).

• **Smell** affects mood and spatial perception. Pleasant scents enhance spatial experiences, while unpleasant odors diminish them. Supporting evidence suggests that integrating natural ventilation, plants, and aromatic materials can improve olfactory experiences.

• **Touch** contributes to the sensory quality of space through materials and textures. The sensation of surfaces, temperature, and ergonomics influences comfort and interaction. Architects often consider tactile qualities in flooring, furniture, and wall finishes to enhance user experience.

7.1.1.2. Emotional Processes:

Architectural Psychology: With advancements in cognitive psychology and neuroscience, researchers have begun to recognize the strong influence of architectural spaces on human emotions, behaviors, and overall well being , This understanding has led to the emergence of architectural psychology, which seeks to explore how design elements impact mood, productivity, and social interactions (Mfon, 2023) , Studies in environmental psychology have also highlighted the critical role of aesthetics in shaping user experiences, demonstrating how specific design features can reduce stress, enhance focus, and improve overall satisfaction.

Emotional Design: refers to the concept of creating designs that evoke emotions, resulting in positive user experiences , Designers aim to engage users on three cognitive levels of emotional experience, as defined by Norman:

Visceral – **Behavioral** - **Reflective** , Each of these levels requires a distinct design approach (Hussein O. I., 2024). Table (1)

TABLE (1) COGNITIVE LEVELS OF EMOTIONAL DESIGN

Visceral Design	Behavioral Design	Reflective Design
This design approach focuses on the external appearance of a product. It refers to the tangible qualities of the product and how they make the user or recipient feel attracted to it and desire it. This design style appeals to the subconscious mind of the individual.	This design approach focuses on the enjoyment and effectiveness of use. Behavioral design is often referred to as "usability" as it relates to the practical and functional aspects of a product or an object that can be used in our environment. For example, behavioral design considers how users perform their activities and how quickly and accurately they achieve their goals through the use of that product or object.	This is the highest level of emotional design, as it considers the intellectual aspect of a product. It represents the layer of conscious thought, where the user approaches the design with awareness, weighing its advantages and disadvantages, and making judgments accordingly. At this level, an individual's judgment becomes more rational and precise, as they extract information and meanings from the design and determine what it signifies to them personally.

7.1.1.3. Symbolic Processes

The Importance of Symbolism in Architectural Design:

Symbols play a crucial role in interpreting complex sensory information, helping users connect buildings to cultural and historical meanings , Architectural elements that reflect a specific culture enhance a sense of identity and belonging, making architecture a powerful tool for cultural communication (Pallamaa, 2005).

Famous landmarks use symbols to represent values and historical events, enhancing their cultural significance and making them key tourist and historical attractions. For example, mosques and churches hold deep symbolic roles, where domes, minarets, and altars express concepts of faith and spirituality , Similarly, pyramids symbolize strength, stability, and continuity through their geometric form, reflecting the religious and cultural beliefs of ancient civilizations , Museums and cultural centers also use symbolism to enrich user experience and add psychological and cultural depth to architectural spaces (Rapoport, Amos, 1990).

Symbolism is an essential part of perception in architecture, as it enhances the cultural and psychological meanings of buildings, creating profound sensory experiences for users (Peter Herrle, 2009).

8. THE ROLE OF PERCEPTUAL PROCESSES IN ARCHITECTURAL DECISION MAKING AND SPACE FORMATION.

Architectural design, like other intellectual activities, involves handling vast amounts of information, requiring rapid processing during the design process. Researchers have shown that design productivity is linked to the designer's ability to manage and organize information efficiently. Utilizing mechanisms such as *chunking* information helps facilitate decision-making (Al-Qaymaqji, 2018).

Based on the previously studied perceptual processes, it can be concluded that they play a significant role in design decisions through:

Sensory Perception and Its Role in Spatial Awareness

People perceive architectural spaces through their senses, with materials, colors, and lighting significantly influencing perception , These elements contribute to feelings of comfort, openness, restriction, or overcrowding.

The Influence of Color and Light on Design Decisions

- **Colors play a crucial role in emotional and psychological responses**, affecting the user's experience inside buildings. Their impact goes beyond bold tones to include natural materials and paint finishes, making color a fundamental element in both interior and exterior architecture.
- **Colors do not function independently of their environment**; instead, they interact with light, shadows, and surrounding elements, making color design a complex process. Users' color perception varies based on psychological state and cultural background (Al-Muhtadi, 2013) (Al-Gharbawi, Faisal Khalil Ibrahim, 2019).
- **The Psychological Effects of Colors** (Mohsen, 2010)
- Colors have a profound impact on emotions and psychological perception, altering spatial experiences and overall mood.
- **Perception of Warmth and Coolness:** Warm colors like red and orange create feelings of warmth and energy , Cool colors like blue and green induce calmness and a sense of coolness, influencing how a space's temperature is perceived (Gage, J, 1999).
- **Perception of Happiness and Sadness:** Bright colors like yellow enhance happiness and positivity , Dark colors like gray and black, when overused, may increase feelings of sadness and gloom (Elliot, A. J., & Maier, M. A, 2014).
- **Psychological Impact:** Colors directly influence emotions and behavior , Blue promotes relaxation and tranquility , Red increases excitement and alertness, making it suitable for spaces that require attention and activity (Heller, E, 2009).
- **Perception of Weight:** Dark colors like brown and black create a sense of heaviness and stability , Light colors like white and beige evoke a feeling of lightness and flexibility (Ou, L. C., Luo, M. R., Woodcock, A., & Wright, A, 2004).
- **Spatial Impact:** Light colors like white and pale blue make spaces appear larger and more open , Dark colors like deep red and brown create a sense of enclosure, making spaces feel smaller and more contained.

Design Decision-Making for Colors:
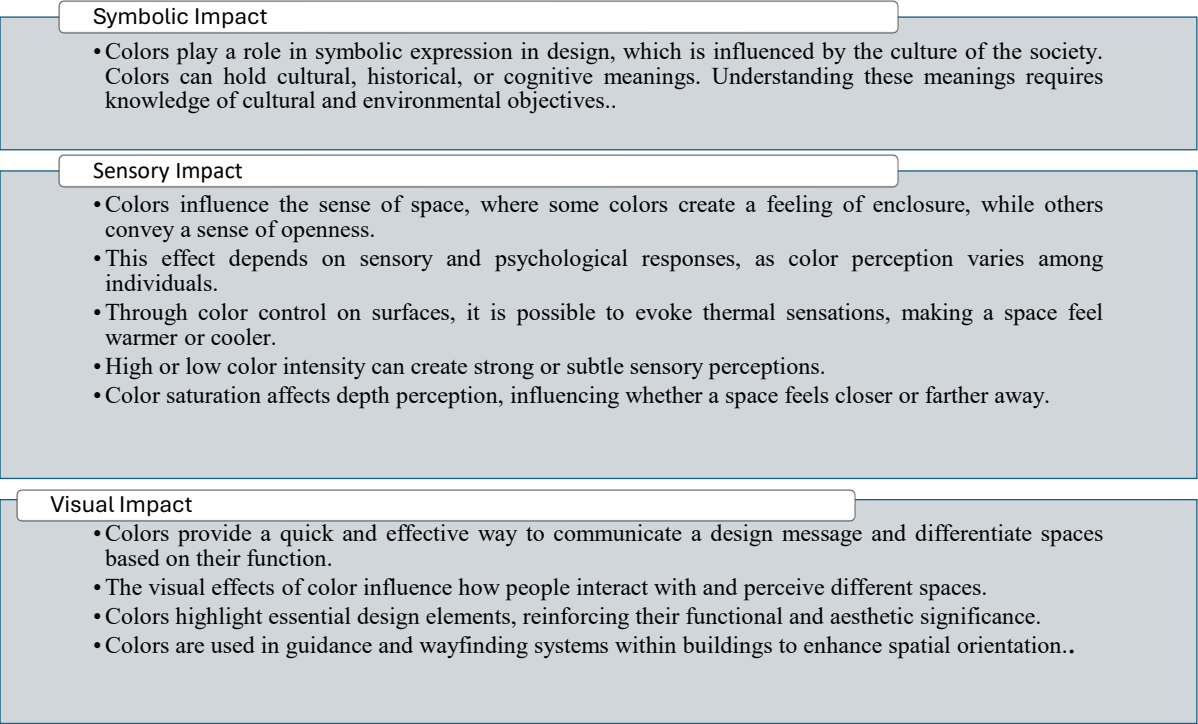
Color design is based on three effects (Figure (6))

Symbolic Impact

- Colors play a role in symbolic expression in design, which is influenced by the culture of the society. Colors can hold cultural, historical, or cognitive meanings. Understanding these meanings requires knowledge of cultural and environmental objectives..

Sensory Impact

- Colors influence the sense of space, where some colors create a feeling of enclosure, while others convey a sense of openness.
- This effect depends on sensory and psychological responses, as color perception varies among individuals.
- Through color control on surfaces, it is possible to evoke thermal sensations, making a space feel warmer or cooler.
- High or low color intensity can create strong or subtle sensory perceptions.
- Color saturation affects depth perception, influencing whether a space feels closer or farther away.

Visual Impact

- Colors provide a quick and effective way to communicate a design message and differentiate spaces based on their function.
- The visual effects of color influence how people interact with and perceive different spaces.
- Colors highlight essential design elements, reinforcing their functional and aesthetic significance.
- Colors are used in guidance and wayfinding systems within buildings to enhance spatial orientation..

Figure (6) Effects of Colors in Design

Finally, architectural decision-making through an understanding of perceptual processes relies primarily on understanding how individuals prefer to use different spaces while considering the functional aspect of the building (Botton, 2014) (Zumthor, 2006).

9. ANALYTICAL STUDY:

Some analytical examples of how sensory perception is used to influence visitors.

National Museum of African American History and Culture (Table (2))

TABLE (2) NATIONAL MUSEUM OF AFRICAN AMERICAN HISTORY AND CULTURE

Location	Washington

Architectural Design: Designed by an architectural team led by David Adjaye, in collaboration with the Freelon Group, Davis Brody Bond, and SmithGroup. The museum stands as an important architectural landmark and a testament to African American history and culture.

Tools for Using Symbolic and Sensory Perception in Design:

Ideas the designer used to support symbolic and sensory perception in the design:

Symbolic Design: The symbolic dimension is evident in the building's exterior design, inspired by the crown atop the Yoruban caryatid columns, an upper element of a traditional column in West African architecture. This visual composition reinforces African American cultural identity, expressing the themes of strength and perseverance that characterize the history of this culture.

The symbolic aspect is also clearly present in the entrance portico design, where a semi-enclosed space creates a smooth transition between the interior and exterior. This element fosters a sense of meeting and gathering, suggesting unity and cohesion within the American community at a central point that brings them together.

Visual Perception:

Visual perception was enhanced in the design through:

Structural-Composition:
The building features a unique form composed of three tiers, reflecting the clear image of a traditional African crown, making it a visually striking structure that stands out in the broader context of the National Mall.

Exterior-Ornamentation:
The building's exterior is adorned with 3,600 bronze panels inspired by the ornate ironwork found in Southern U.S. cities such as Charleston, South Carolina. These decorations reflect the African American artisanal heritage, linking the building to its cultural roots.

Interior-Views:

The design provides comprehensive visual connections through openings that overlook key landmarks in the area, such as the Washington Monument, Federal Triangle, Capitol Building, National Mall panorama, White House, Lincoln Memorial, and Martin Luther King Jr. Memorial. These views strengthen visual connections to the location and national identity.

Conclusion:

The designer integrated symbolism and visual appeal by utilizing architectural elements with symbolic references, like the crown atop the Yoruban caryatid columns, and controlling the spatial forms, like the semi-open entrance portico representing a meeting point for Americans. This symbolic aspect was emphasized through external visual attraction, using a specific pattern on the façades made of ornate bronze ironwork, creating a sensory impact with light and shadow contrasts through its openings. Visual connections between the inside and outside were also reinforced through the alignment of the building's openings, directing views towards significant landmarks in the area.(Figure (7)- Figure (8)- Figure (9))

Source: Adapted by the researcher: (Bunch, L.G., & Wilson, S, 2016) - (Smithsonian Institution, 2020) - (Wilson, M, 2018)

Figure (8) Contrast Between Light and Shadow - Source :(https://www.wired.com, n.d.)

Figure (7) The National Museum of African American History and Culture
source :(https://perkinswill.com, n.d.)

A Washington Monument
B Federal Triangle
C The Capitol
D Mall Panoramic
E The White House
F Jefferson Memorial
G Lincoln Memorial
H MLK Memorial
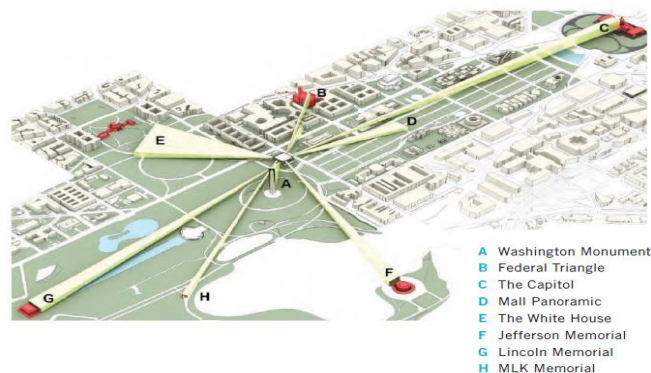
Figure (9) Interior View of Key Landmarks in the Area
(https://dcarchcenter.org, n.d.) Source

The Jewish Museum in Berlin:

The project is an architectural competition aimed at establishing a new Jewish museum as an extension of the old Jewish museum in Berlin. It symbolically reflects the painful events experienced by the Jewish community.

The museum is located in Germany, a country that witnessed Nazism and left a deep impact on the hearts of the Jewish people. Table (3).

TABLE (3) THE JEWISH MUSEUM IN BERLIN , SOURCE: ADAPTED BY THE RESEARCHER (LIBESKIND, D, 2000) (BETSKY, A, 2015)

Location:	Berlin, Germany
Architectural Design:	
Designed by Daniel Libeskind, the museum seeks to express Jewish heritage and the stories of Jewish displacement and suffering under Nazism. The architect incorporated sensory perception into the design, drawing inspiration from the story of Prophet Abraham, who was saved from fire, and the story of Prophet Joseph, who endured hardship before gaining power.	

Tools for Using Sensory Perception in Design:

Ideas the designer used to support sensory, emotional, and symbolic perception in the design:

Embodiment of Survival (The Story of Prophet Abraham):

The architect drew inspiration from the story of Prophet Abraham, who was thrown into fire by his people, but it turned into coolness and safety, symbolizing survival.

Architectural Application:
A tower at the museum's end was designed to resemble the Holocaust Tower, featuring no windows except for a single opening in the ceiling. Inside the tower, a tall staircase is intentionally inaccessible. Integrated metal openings in the walls create a sense of fear, evoking the danger of fire. This design aims to create a sensory experience that mirrors survival, making visitors feel as if they have emerged unscathed from a situation similar to Prophet Abraham's survival from fire. .

Embodiment of Resilience (The Story of Prophet Joseph):

The architect also drew inspiration from a story in the Old Testament that recounts the suffering of Prophet Joseph.

The design concept was inspired by Prophet Joseph's journey of imprisonment and hardship before gaining power and reuniting with his family. The story symbolizes hope and overcoming adversity.

Architectural-Application:
The concept was applied in the design of the Jewish Museum in Berlin through narrow corridors resembling mazes. Upon entering, visitors encounter a slanted passage leading to an underground chamber known as the *Path to Global Abyss*, symbolizing Joseph's descent into the well. The museum spaces are designed on underground levels to resemble prison cells, making visitors feel isolated and distressed, much like Joseph's experience in prison. The passage ends with the *Stairway of Hope,* symbolizing Joseph's release from prison and rise to power, enhancing the emotional and symbolic perception of the space.

Experience of Exile (The Story of Prophet Moses):

The architect drew inspiration from the story of Prophet Moses, who was placed as an infant in a basket and set adrift on the Nile, where the current carried him until Pharaoh's wife adopted him. The story reflects displacement and the search for identity.

Architectural   Application:
The Garden of Exile was designed with a special incline, creating an unbalanced experience for visitors, resembling the movement of a basket on water. Ten-meter-high concrete columns were used to make visitors feel small and isolated, symbolizing Moses' experience as a child in difficult circumstances. The design aims to evoke feelings of loss and displacement, enhancing visitors' understanding of the historical and cultural experience of exile.

Conclusion: By integrating symbolism and religious narratives into the design, the architect created a building that enhances sensory, emotional, and symbolic perception through architectural elements. For example, he deconstructed the Star of David, a prominent Jewish symbol, to explore themes of loss and suffering. The use of zigzag lines in the design represents the turbulent experiences of the Jewish people, such as death and displacement.

The incorporation of symbolism and meaning through architectural elements allows the museum's structure to convey complex ideas and emotions. This strategy goes beyond traditional architectural aesthetics to create a narrative that engages visitors on multiple levels. Figure (10)- Figure (11)
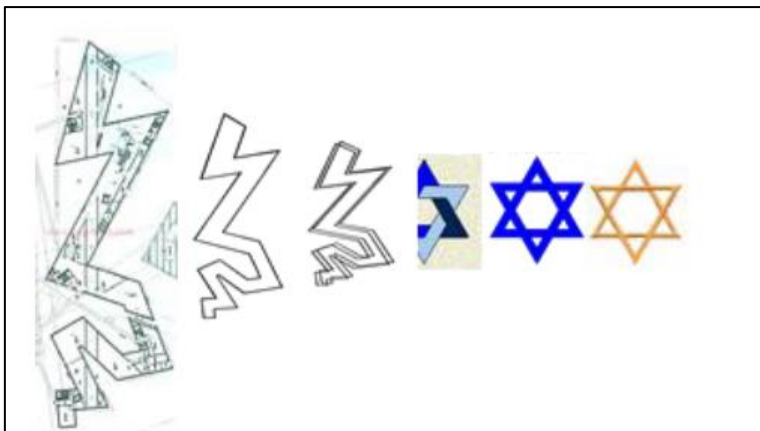
Figure (11) Deconstruction of the "Star of David" and the Removal of Its Triangular Centers to Symbolize Loss, Absence, and Death **- Source**:: (https://culturevulture.net/art-architecture/jewish-museum-berlin , n.d.)

Figure (10) Spatial Simulation of the Story of Prophet Joseph **-Source:** (https://culturevulture.net/art-architecture/jewish-museum-berlin , n.d.)

10. RESULTS OF THE ANALYTICAL STUDY:

The first example, The National Museum of African American History and Culture, integrated symbolic perception and sensory perception through visual attraction, which enhanced the building's function. The design strongly focused on visual appeal, both internally and externally.

The second example, The Jewish Museum in Berlin, incorporated symbolism and religious narratives into the design through sensory, emotional, and symbolic perception , The use of all three dimensions of perception emphasized the unique identity of the place and its significant impact on visitors.

Through the analytical study and the theoretical examination of the dimensions of perception, which include:

- Sensory perception through the senses,

- Emotional perception, which is based on emotions and feelings,

Symbolic perception, which relies on meanings and mental images formed and reinforced over time , It is evident that buildings designed for exhibitory purposes primarily rely on enhancing sensory perception, particularly visual perception, while also reinforcing the experience through the other dimensions of perception, such as symbolism and emotional perception.

11. CASE STUDY (JEWELRY PALACE MUSEUM IN ALEXANDRIA) FIGURE (12)

11.1. Palace Description (Suleiman, 2013)

The palace is located in the Zizania district in Raml, Alexandria, with its main southeast façade overlooking Ahmed Yehia Pasha Street , The palace was built by Zeinab Hanem Fahmy in 1919, and later completed and inhabited by her daughter, Princess Fatima Haidar, in 1925. The construction was supervised by the architect Ali Fahmy.

The palace was designed in the European Baroque and Rococo styles and consists of two wings: Figure (13)

- The western wing, which is the oldest,

- The eastern wing, connected by a transverse corridor (Belvedere).

In the northern corner of the palace courtyard, there is a car garage, and the palace is surrounded by an ornate wrought iron fence.The palace was built in multiple stages, which gave each section a distinct character , The design's creativity lies in the fact that, despite the independence of each part, the palace appears as a harmonious architectural unit.

11.2. Architectural Composition of the Palace

Figure (12) Perspective View of the Palace – **Source:** (https://egymonuments.gov.eg, 2024)
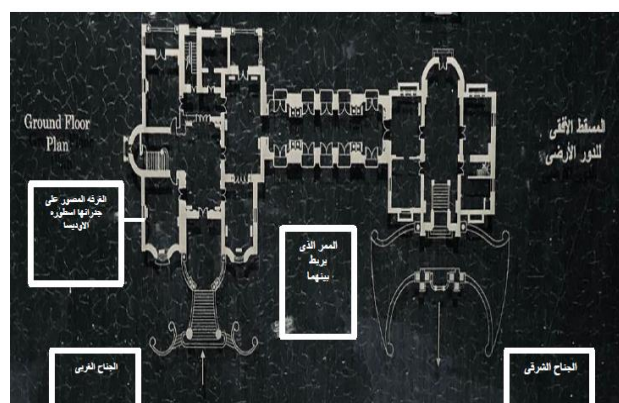
Figure (13) Ground Floor Plan of the Palace – Source: (Darwish, Dalia Ahmed Ahmed, 2021)

Western Wing of the Palace:

Architectural-Composition:

The wing consists of two floors, a basement, and two servant rooms on the rooftop. It has four façades, all characterized by symmetry and balance , The southeastern façade is the main façade, featuring a prominent entrance with a flying veranda above it , A white Carrara marble staircase with red marble inserts leads up to the entrance, which is framed by an ornate wrought iron door. Below the main entrance, the basement has a wooden

door, opening to a central hall surrounded by six rooms, with a bathroom and kitchen at the front. A marble service staircase leads to the upper floors, continuing up to the roof , The first floor has a rectangular central hall surrounded by four halls, in addition to an office and a bathroom beneath the staircase leading to the second floor.

First Floor:

- Northern Hall: (Walls: Oak wood paneling – Ceiling: Paneled with floral decorations – Floors: Zigzag-patterned parquet flooring).
- Eastern Hall: (Walls: Decorated wood paneling – Ceiling: Central circular panel with oil paintings – Floors: Parquet made of high-quality woods such as oak, mahogany, and Turkish walnut, arranged in floral and geometric patterns using the marquetry technique).
- Southern Hall: (Walls: Wooden paneling – Ceilings: Oil paintings – Floors: Geometric parquet designs using the marquetry technique).
- Western Hall: (Gothic architectural influence – Walls: Azizi wood paneling designed to resemble curtain folds – Ceiling: Wooden beams supported by decorative brackets – Floors: Parquet in marquetry style).
- Office: (A transverse corridor connects the northern and western halls – Walls: Decorated with ceramic tiles featuring raised floral and geometric patterns – Floors: Mosaic tiles with vine-like designs).

Second Floor:

The central hall is surrounded by four rooms and two bathrooms. This floor was originally used as a sleeping area.

- Northern Hall: A rectangular hall with no ornamentation, except for a plaster cornice running along the upper walls, featuring raised floral decorations.
- Main Bathroom: A remarkable architectural masterpiece, known for its artistic design. (Walls: Covered with ceramic tiles – Ceiling: Features a stained glass skylight – Floors: Colorful mosaic tiles, some gilded).
- Eastern and Southern Halls: (Ceilings: Central oil painting on fabric, framed within a rectangular wooden cornice – Floors: Zigzag-patterned parquet).
- Western Hall: A plain hall with no ornamentation, except for a plaster cornice running along the upper walls with raised floral decorations.
- Small Bathroom: Similar in design to the first-floor office.

Eastern Wing of the Palace:

Architectural-Composition:

The wing consists of two floors and a basement. The first floor was designed for reception purposes, while the second floor was dedicated to a tea hall. The wing has four façades:

- The southwestern façade serves as the main façade.

- The northwestern façade extends outward in a semi-circular form, with the basement entrance located at its center.

First Floor: The floor consists of a central hall, flanked by two halls and a small bathroom , It was primarily used for official meetings.

- Northeastern Hall: (Square-shaped – Walls: Dark brown wooden paneling with no decorations – Ceiling: Gilded floral motifs in Rococo style – Floors: Parquet made of dark brown walnut, red oak, ash, and yellow mahogany, arranged in geometric patterns).

- Small Bathroom: (Walls: White and blue ceramic tiles – Floors: Mosaic tiles with a similar design).

- Southwestern Hall: (Plain hall with no ornamentation, except for a plaster cornice along the upper walls).

Second Floor (Tea Hall): This is the last floor of the wing, entirely occupied by the tea hall , It is accessed through a door in the northeastern wall of the northern hall in the western wing.

A questionnaire was designed to study the various influences on visitors' perceptual experiences at the Jewelry Palace Museum and how these factors impact the exhibits and visitor experience. Table (4)

TABLE (4) SURVEY DATA

Survey Objective:	To study the various factors affecting the perceptual process of visitors at the Jewelry Palace Museum and their impact on the exhibits, including artifacts and jewelry.
Survey Sample:	Data was collected from **123 visitors** of different age groups.
Survey Timing:	May 2025
Survey Type:	Closed-Open Questionnaire
Number of Questions:	14 Questions

The survey was conducted using the OneDrive Forms application, where a QR Code was placed at the end of the visitor's tour. The survey included simple questions, requiring either multiple-choice answers or written responses if necessary.

Here is a sample of the questions presented to visitors:

- During your tour of the palace spaces, what were the most noticeable features that caught your attention?

- Were there any specific colors that remained in your memory from the spaces you visited?

- Which space did you find most impressive?

- Which valuable exhibit attracted your attention the most?

- Did you experience any psychological impact after completing your tour?

- Did you notice any distinct scents from the materials used in the palace that you still remember?

- Did you feel distracted by the way the jewelry and artifacts were displayed?

- Did you feel comfortable and at ease while moving around the palace during your tour?

11.3. Data Analysis:

According to the collected data, the results show that approximately 67% of visitors (82 individuals) reported that the most captivating elements were the painted and suspended ceilings. Additionally, 22% (27 individuals) of the total sample stated that the overall interior design of the palace attracted their attention. Meanwhile, 11% of the respondents(14 individuals) indicated that the jewellery and displayed artifacts were the most attention-grabbing aspects of their tour.

Regarding the psychological impact of the visit, 64% (79 individuals) of visitors reported feeling a sense of amazement and happiness, while 36% (44 individuals) stated that they did not experience any particular emotional effect.
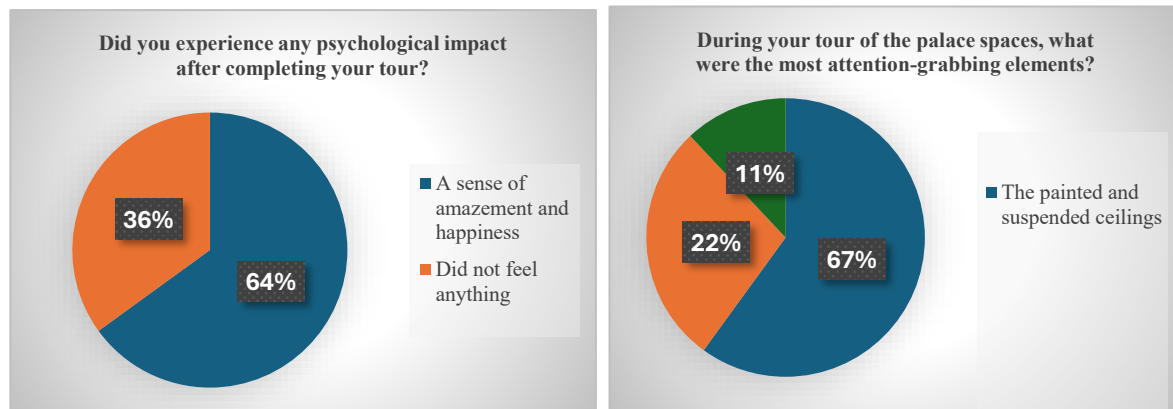
The results of the question regarding the colors that remained in visitors' memory after the tour showed that the majority, 65%,(80 individuals) recalled warm colors (red – orange – yellow), while a smaller percentage, 35%(43 individuals) remembered cool colors (blue – green).

Regarding the most admired spaces, the highest percentage, 73%,(90 individuals) favored the bathrooms and sanitary spaces in general. A smaller percentage, 27% (33 individuals), preferred the exhibition spaces displaying jewelry and artifacts.
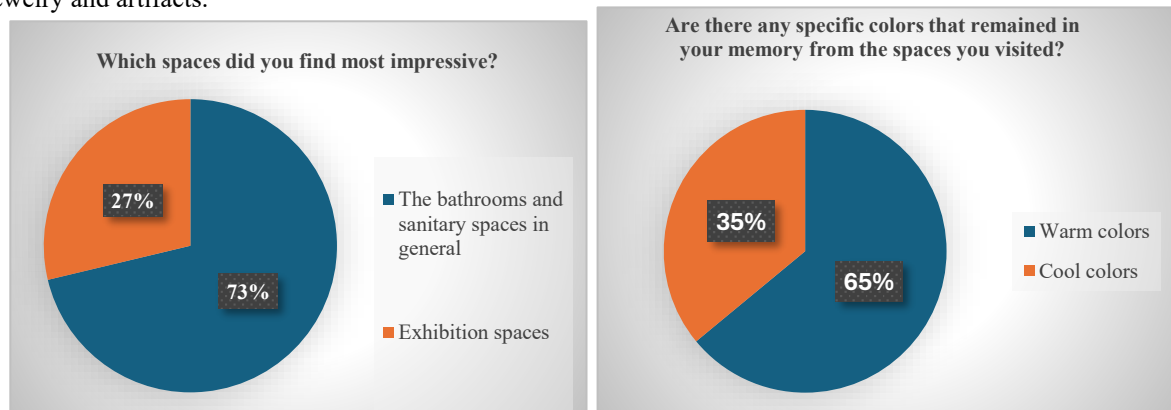
The survey results, based on the question about the most valuable exhibit that caught visitors' attention, showed that the majority, 62%(76 individuals) reported feeling distracted and unable to specify a particular piece. Meanwhile, a smaller percentage, 38%(47 individuals) stated that all the exhibits caught their attention.

When visitors were asked about any lingering scents from the materials used in the palace, the majority, 57%, (70 individuals) confirmed that they noticed the distinct scent of wood from the flooring, while 43% (53 individuals) stated that no specific scents remained in their memory.
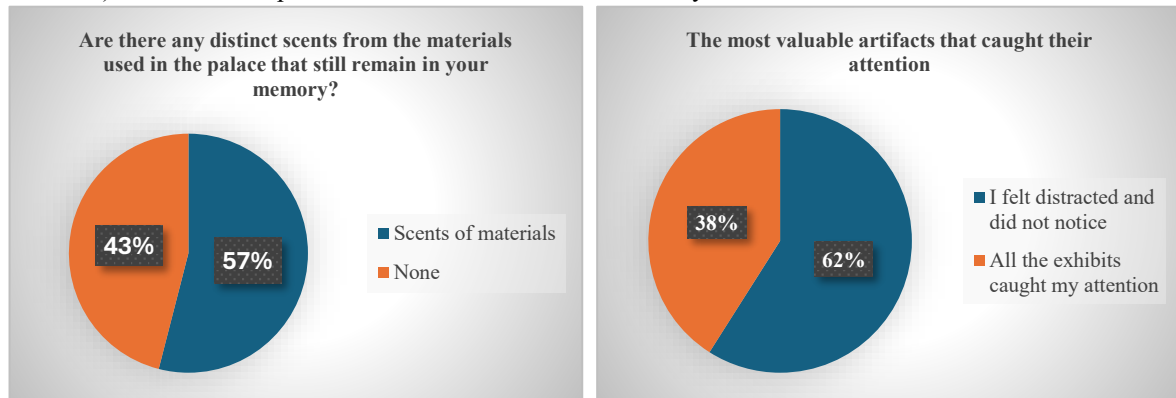
The results of the question "Did you feel distracted by the way the artifacts were displayed?" showed that the majority, 69%(85 individuals) answered yes, they felt distracted.

The results of the question "Did you feel comfortable and find it easy to move around?" showed that the majority, 57%(70 individuals) answered yes.

At the end of the survey, visitors were asked if they had any comments about the way the artifacts and jewelry were displayed in the palace spaces. Most responses suggested that the display arrangement should be changed to reduce distraction, while some opinions proposed that the valuable artifacts should be placed in a separate area to allow visitors to fully appreciate the interior design of the palace.

11.4. Discussion of Survey Results:

Based on the collected data and visitors' feedback, it was found that:

- The previous percentages clearly reflect a high level of sensory perception through visual attraction among visitors, but not toward the exhibits as intended. Instead, the interior design of the museum—including the painted and suspended ceilings, architectural decorations, and wooden wall paneling—was the main visual focus, as indicated by the survey responses. This conflicts with the museum's primary function, which is to highlight the displayed jewelry and artifacts.
- The results also revealed a high recall rate for the sanitary spaces, particularly the bathrooms, even though they contain no exhibits. This suggests that some distraction occurred in other spaces, where visitors were supposed to focus on the artifacts. The strong visual attraction of the interior design contributed to this sense of distraction.
- Regarding the question about the most valuable artifact that caught visitors' attention, the majority responded with "I felt distracted and couldn't decide." This confirms that visual distraction occurred during their tour of the museum.
- The responses to the question about suggestions for improving the display arrangement mostly focused on the distraction caused by the detailed paintings and decorations on the ceilings and walls, competing with the displayed artifacts. Some responses suggested dedicating a single area for displaying the jewelry to reduce distraction and allow visitors to enjoy both the exhibits and the palace's interior design.

12. RESULTS AND RECOMMENDATIONS

12.1. Architectural Design Findings:

- Memory plays a crucial role in decision-making, and architectural design is fundamentally based on making design decisions that align with the project's requirements.
- Most surrounding designs focus on only one aspect of perception visual perception emphasizing image alone, which creates an imbalance in some design elements due to the neglect of other perceptual dimensions.
- A lack of sufficient awareness among designers regarding the perceptual process and its three dimensions limits the ability to make design decisions that integrate both functional and psychological requirements.

- Visual attraction in spaces is not always the best solution; in some cases, visual separation can be the most effective way to solve certain design problems.
- Studies on the importance of sensory perception in capturing attention in architectural design indicate that: Vision accounts for 70% of attention attraction , Hearing 20% , Smell 5% , Touch 4% , Taste 1%.

However, low impact senses can still be utilized to solve architectural problems and influence users. For instance, sound perception affects comfort and functionality, as good acoustic design enhances concert halls, offices, and residential spaces. Studies support this by showing that poor noise control leads to stress and reduces productivity, highlighting the importance of considering sound in design.

Therefore, when incorporating hearing as a design element, it is essential to analyze acoustic phenomena, understand sound propagation, and its psychological effects, to evoke specific emotional responses. Similarly, touch perception, represented by materials and surface textures, contributes to the tactile quality of a space. The sensation of surfaces, temperature, and environmental ergonomics plays a key role in comfort and interaction. Supporting evidence suggests that architects often consider tactile aspects in flooring, furniture, and wall finishes to enhance the user experience.

- There is a need for continuous research and innovation to further explore architectural psychology and emotional design, and to understand how to create designs that evoke emotions and enhance user experiences positively.

12.2. Case Study Findings:

- Based on the survey results, it can be concluded that sensory perception, particularly visual perception, had the strongest impact in the museum, more than emotional and symbolic perception.
- The challenge lies in how to balance visual attraction between the exhibits (jewelry and artifacts) and the palace's interior design, while also addressing visitor distraction caused by excessive visual stimuli.

Based on previous studies on visual attraction using modern technology, a visual separation strategy can be implemented in the museum through:

1. Creating two visitor paths:

- The first path starts from the western wing and ends at the eastern wing, dedicated exclusively to viewing artifacts and jewelry.
- The second path follows the reverse direction, beginning from the eastern wing and ending at the western wing, allowing visitors to focus on and appreciate the palace's interior design, including the ceilings, walls, and flooring.
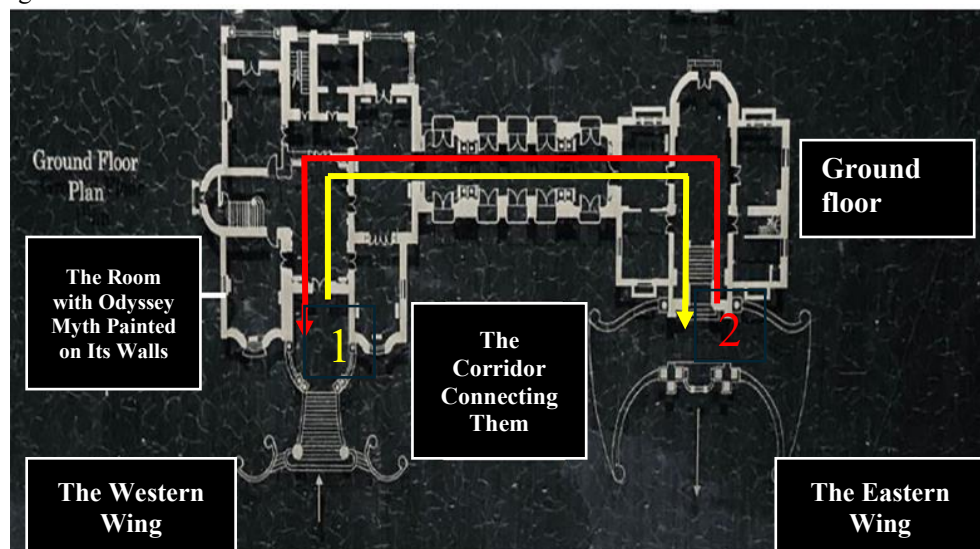
Figure (14) Proposed Tour Routes in the Museum – Source: Adapted by the Researcher
(Darwish, Dalia Ahmed Ahmed, 2021)

2.   Using the concept of (3D projectors) to create uniform-colored virtual surfaces projected onto the walls and ceilings during the first visitor path.

• This technique ensures visual separation, allowing visitors to focus solely on the exhibits until they have completed their viewing.
• Once the visitor transitions to the second path, the projections are turned off, shifting the focus to the interior design of the museum.

Figure (15) Illustration of the Concept of Using Hologram Technology for Visual Separation in the Museum -Source: Adapted by the Researcher (https://egymonuments.gov.eg, 2024)

The findings of the study can be summarized as follows : the importance of integrating multiple senses within architectural design. Sensory modalities that are often relatively overlooked such as hearing, smell, and touch demonstrated a clear impact on sensory comfort, emotional engagement, and cognitive focus. The observed levels of perceptual distraction, difficulty in recalling exhibited items, and stronger impressions of non-exhibit spaces highlight the necessity of adopting a purposeful perceptual hierarchy in museum design.

Through the practical strategies proposed in the study such as the use of visual separation techniques via designated visitor pathways and light projection technologies it was demonstrated how memory and perception theories can be employed to address real design challenges. This affirms the architect's potential to design for **experience**, not merely for **appearance.**

13. RECOMMENDATIONS:

- Understanding and recognizing the components of memory is essential for making the right decisions during the design process.
- All dimensions of the perceptual process should be integrated into architectural design to support decision-making and solve design-related problems.
- Perceptual dimensions can be controlled by studying sensory, emotional, and symbolic processes and introducing key variables that influence them. This approach helps in making effective design decisions that align with the overall design requirements.
- Modern technology should be utilized as an architectural design element to create innovative architectural solutions.

Architectural education should be enhanced by incorporating architectural psychology and emotional design into architectural design curricula.

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