Design Exploration Seminar
DES

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CONSTRUCTIVE TOYS



A category of toys which helps users to build on their ideas, designed to encourage either;

- creativity
- spatial understanding
- story telling
- visual images
- problem solving
- cognitive development
- fine motor skill development...



Incredibly powerful learning tool for children.

- **Maths** – Exploring counting, shapes, sizes, symmetry in their construction
- **Science** – Seeing cause and effect, gravity, and balance in action, and building problem solving skills
- **Understanding the world** – Exploring the attributes of different objects and natural materials, and playing with how one object can represent another.
- **Creativity** – Taking an idea, and seeing it through in real life. Designing their own play and choosing different materials.
- **Develops imagination** – Small world play allows them to build characters and universes into their play.
- **Physical development** – Construction play develops children's gross and fine motor skills.
- **Curiosity** – Exploring materials with inquiry and interest.
- **Language** – Teachers can scaffold with complex and intricate vocabulary.
- **Cooperation and social skills** – As children build together they learn how to work together.
- **Self-esteem** – Building confidence as they control their own environment.

Characteristics

- Encourages Building or Assembling
- Open-Ended Play - There is no "right" way to play
- Problem-Solving and Critical Thinking - how pieces fit together, balancing elements, or achieving specific goals.
- Allows Iteration and Experimentation
- Hands-On Interaction
- Scalable Complexity
- Imaginative and Explorative Potential
- Repeating basic units

https://www.communityplaythings.com/resources/articles/constructive-play

Sand

One of the most basic constructive toy which is very universal to everyone. It allows children to create structures, shapes, and patterns using their hands or tools like buckets and moulds. It’s open-ended, tactile, and adaptable for various creative expressions, from building sandcastles to drawing designs on the surface.

- Fine motor skills (through scooping, patting, and molding).
- Problem-solving (figuring out how to keep a sandcastle stable).
- Creativity (imagining entire scenes with sand figures).

https://www.famly.co/blog/encouraging-constructive-play



Rangoli

A traditional art form where users create intricate patterns on the ground using coloured powders, rice, or flowers. It involves designing, arranging, and assembling, which are all constructive processes.

- Pattern and spatial recognition (creating symmetrical designs).
- Creativity and aesthetics (choosing colours and shapes).
- Focus and patience



Play dough

It is highly malleable, allowing children to sculpt, shape, and build virtually anything they imagine. It’s a quintessential hands-on material for open-ended creativity.

- Tactile exploration (feeling and moulding).
- Hand-eye coordination and fine motor skills (rolling, cutting, shaping).
- Imaginative play (creating pretend food or animals).

https://weelicious.com/homemade-play-dough/



Kavad

It is a portable wooden shrine with multiple doors and panels that can be opened to reveal intricate stories and artwork. It combines storytelling, interaction, and construction as users physically manipulate the object to explore its narrative layers.

- Imagining narratives (sequencing stories and understanding connections).
- Open ended play (reinterpreting and sequencing stories in different ways)



LEGO

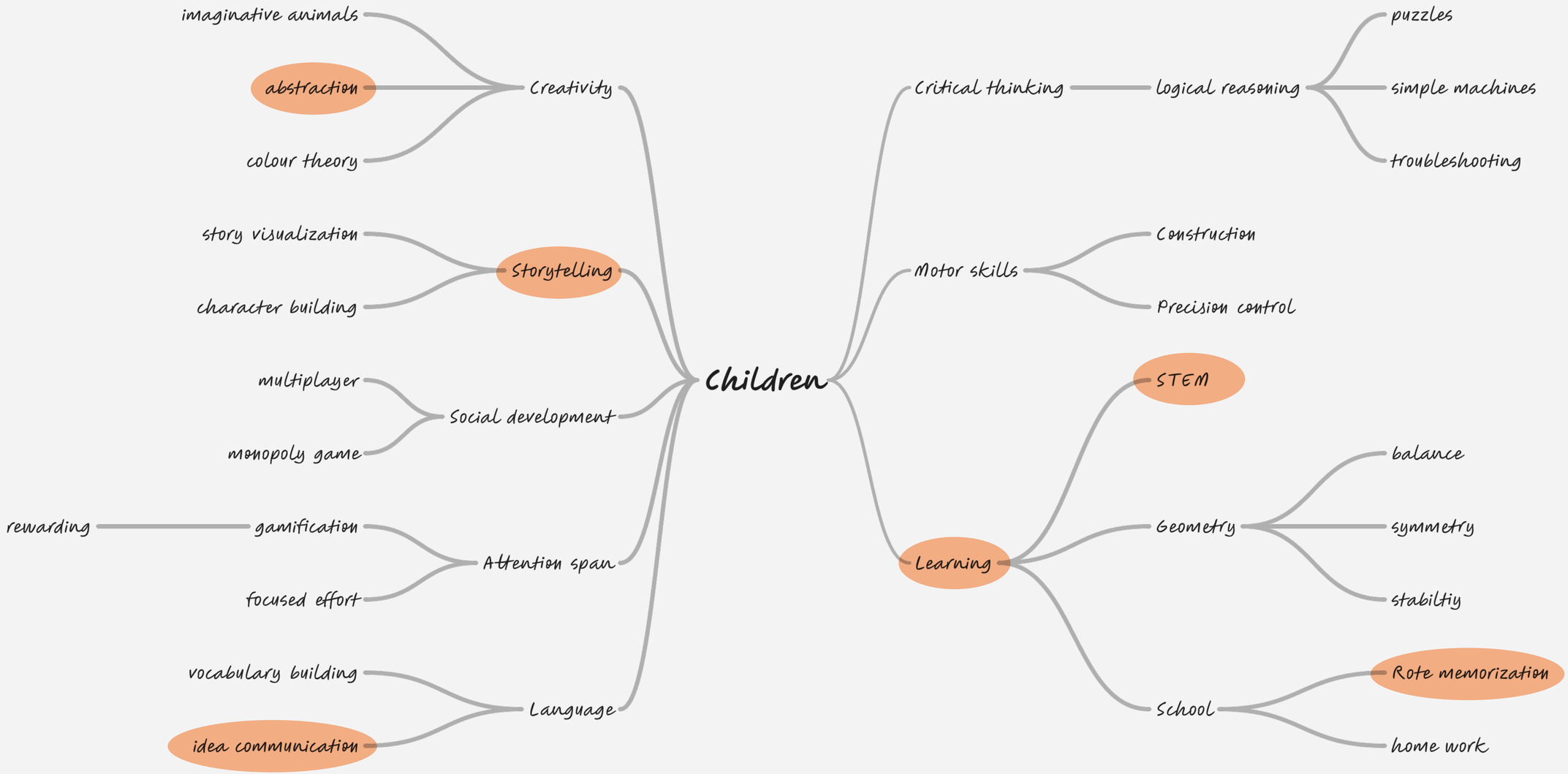
They are the popping example of constructive toys, as they allow users to build anything from simple structures to intricate models. Sets often include guides but also encourage free-form exploration.

- Spatial reasoning and structural physics
- Logical thinking
- Creativity and innovation
- Open ended play
- Similar basic units

https://www.yankodesign.com/2020/12/22/lego-creations-by-master-builders-that-showcase-why-lego-is-not-just-a-childrens-toy-part-6/



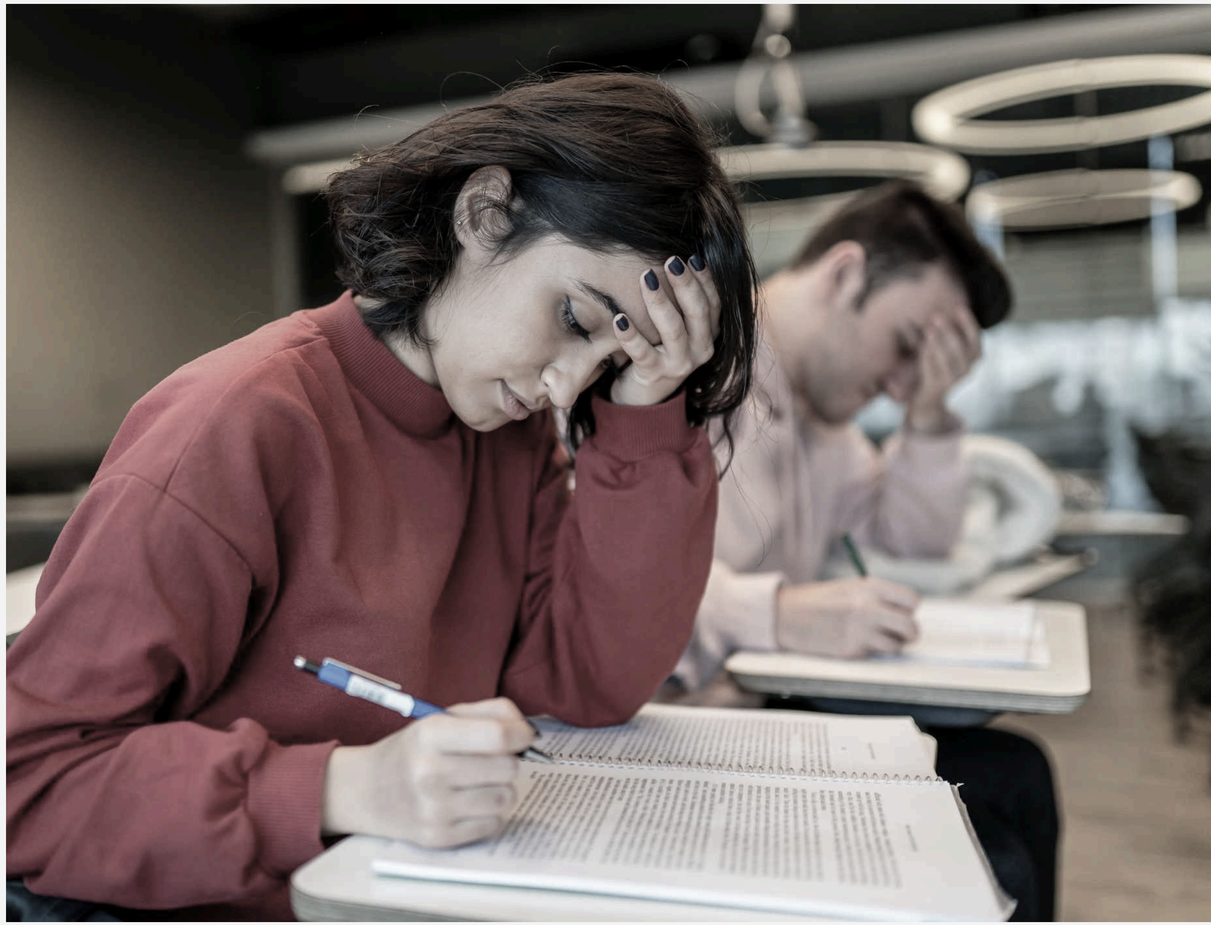
Mind Mapping Opportunities



Rote Learning

Rote memorization is when we repeat a piece of information until we remember it. It's not about any sort of deep learning, and memorizing information doesn't mean you understand it. Advantages of rote learning include that it's helpful for test preparation, and disadvantages include that you won't necessarily remember the info you memorized long term. Rote memorization has its place, but it's not nearly as valuable as meaningful learning.

- Lack of Retention
- Shallow Understanding
- It Doesn't Benefit Your Mind
- Stress and Anxiety
- Inhibits creativity



What they Say?

They just have to get this into their heads.

This is the common way to learn stuff.

Mostly doing this for the exams.

What they Think?

It’s a very boring and routine process.

Better not blank out during the exams.

There is not other way to learn this.

What they Do?

Repeats content aloud or in writing

multiple times.

Uses mnemonics without understanding.

Highlights/underlines blindly.

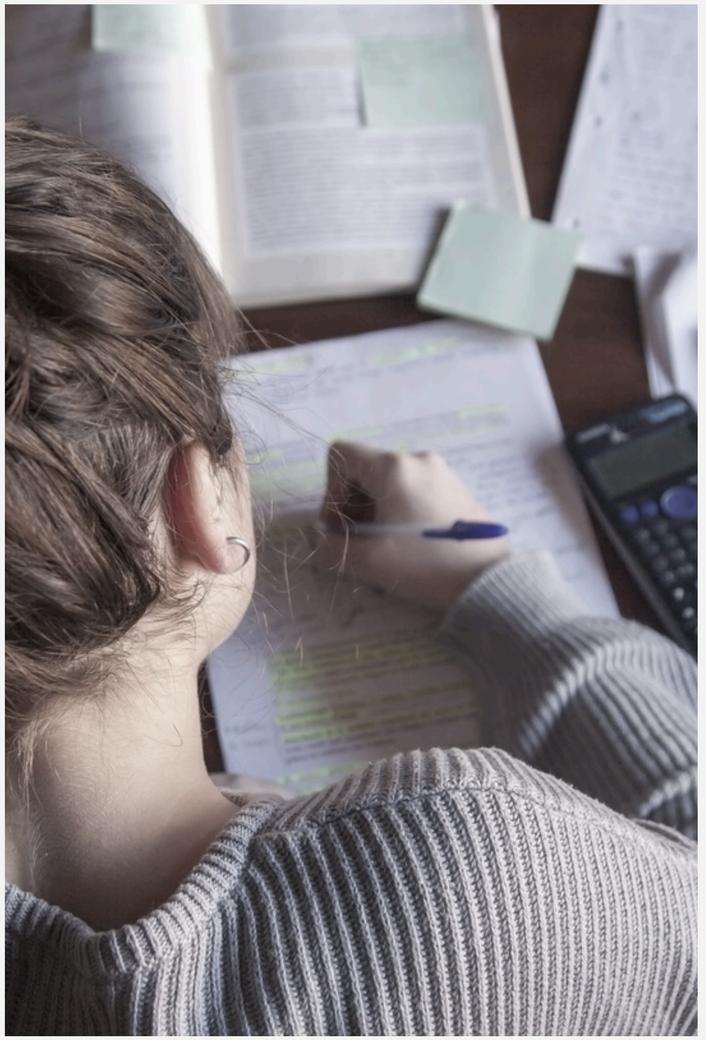
What they Feel?

Frustrated due to lack of understanding.

Worried about performance during exams.

Lack of trust in the memorised content.

Lacks engagement or excitement.



Method of Loci

Also called ‘Mind Palace’, is a mnemonic device, a trick to aid in memory storage and retrieval.

- It uses imagined physical locations to aid memory.
- This works because human beings are very good at remembering spatial information.
- Memory athletes uses this technique to memorise complex lists, the order of a deck, parts of a long speech or events.

https://geographer-at-large.blogspot.com/2011/06/method-of-loci-memory-palace.html



Simonides of Ceos

According to Roman legend, Simonides of Ceos was the inventor of the method of loci.

- Simonides was dining at the house of a wealthy nobleman. Legend has it, Simonides watched the roof of a building cave in and crush everyone inside, leaving him as the only one left to remember all the different people who had died.
- Thus he developed it to be an ancient device to memorise the oral tradition in story-telling.
- Initially used by ancient Greek poets, to memorise long saga-type poems.
- Also mentioned in Aristotle's De memoria et reminiscentia (On Memory and Reminiscence)

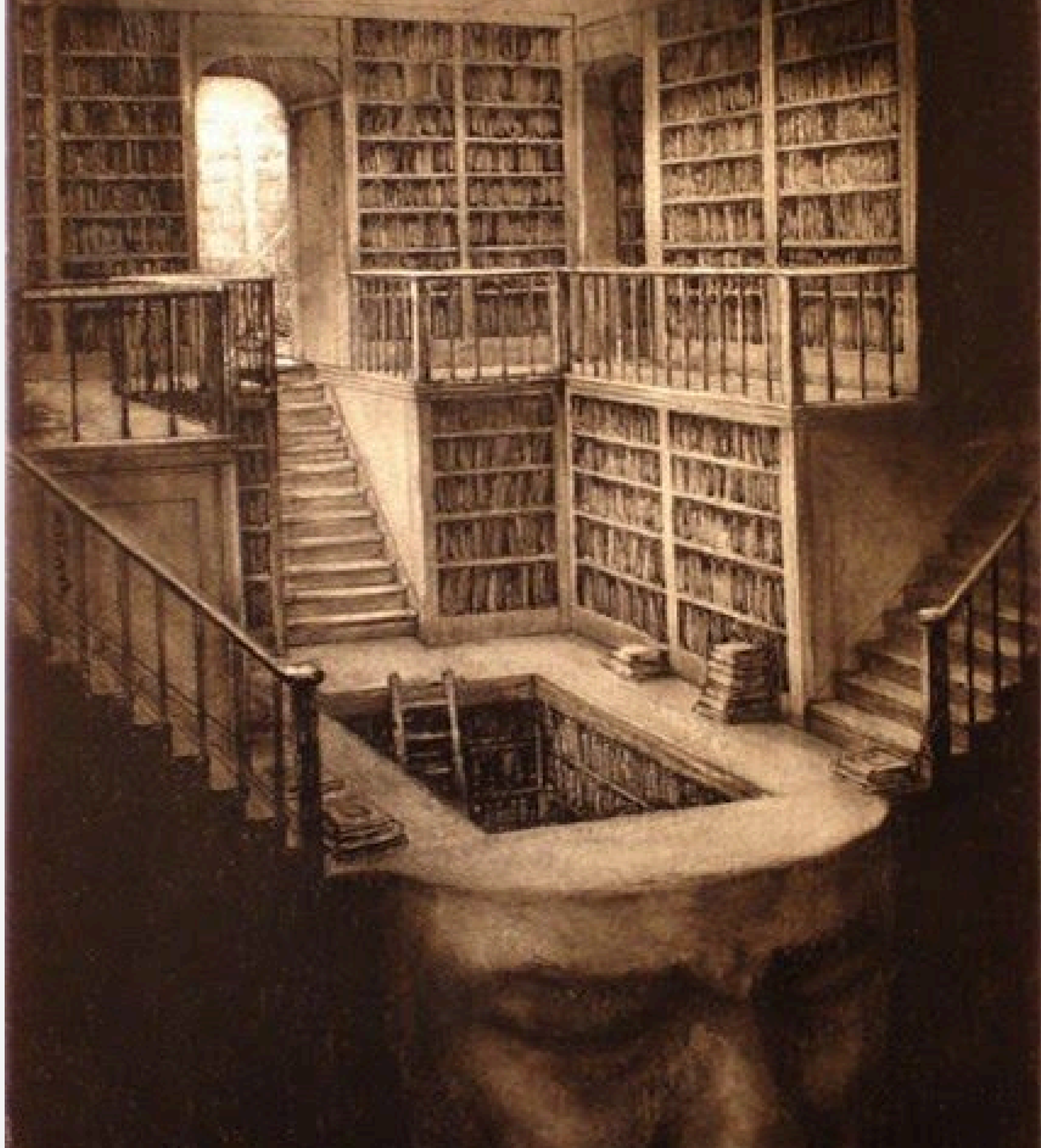
https://artofmemory.com/blog/simonides-of-ceos/



Evolutionary Development

- The human brain evolved with a strong emphasis on visual and spatial processing.
- Our hunter-gatherer ancestors relied heavily on these skills for survival, such as locating food and navigating environments.
- These information are stored in our brain without any amount of effort.
- The modern world of words, numbers, and abstract concepts is relatively new in human history.
- The method of loci leverages these abilities to translate abstract information into a more familiar, visual, and spatial format.
- The data needed to be memorised is anchored in a visuospatial context making it easy to store in our brain.

https://artofmemory.com/blog/



Elaborative Encoding

Translating something that has no great meaning to you into something with extensive connections that will make it much easier for you to retrieve it later.

Practitioners use multiple techniques, such as

- method of loci,
- the link system,
- the peg-word method,
- PAO (person, action, object), etc...

Person-Action-Object (PAO) system

- Technique for long numbers
- Every double figure number (00 to 99) is given a very clear mental image of a person doing an action with an object.
- These actions are memorised in order to store the data.
- Athletes use this technique to memorise the value of pie and other mathematical units.

https://geographer-at-large.blogspot.com/2011/06/method-of-loci-memory-palace.html

How to

Picture a location

- Intimately familiar location
- inside of building, office, room, cabinet, street, body
- allows to mentally navigate through it

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Convert the element to image

- More grotesque, funnier, ridiculous
- More easier to remember
- could add other sensations
- look, feel, taste, smell
- demands creativity

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Place them around the palace

- Through the path you navigate
- Bigger memories, bigger palace
- requires to navigate through palace

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The imagery becomes stronger, when the user revisits the palace often.

The funnier, lewder, and more bizarre, the better.

“When we see in everyday life things that are petty, ordinary, and banal, we generaly fail to remember them, because the mind is not being stirred by anything novel or marvelous.

But if we see or hear something exceptionaly base, dishonorable, extraordinary, great, unbelievable, or laughable, that we are likely to remember for a long time.”

World Memory Championship is less a test of memory than of creativity.
- Tony Buzan, educational consultant

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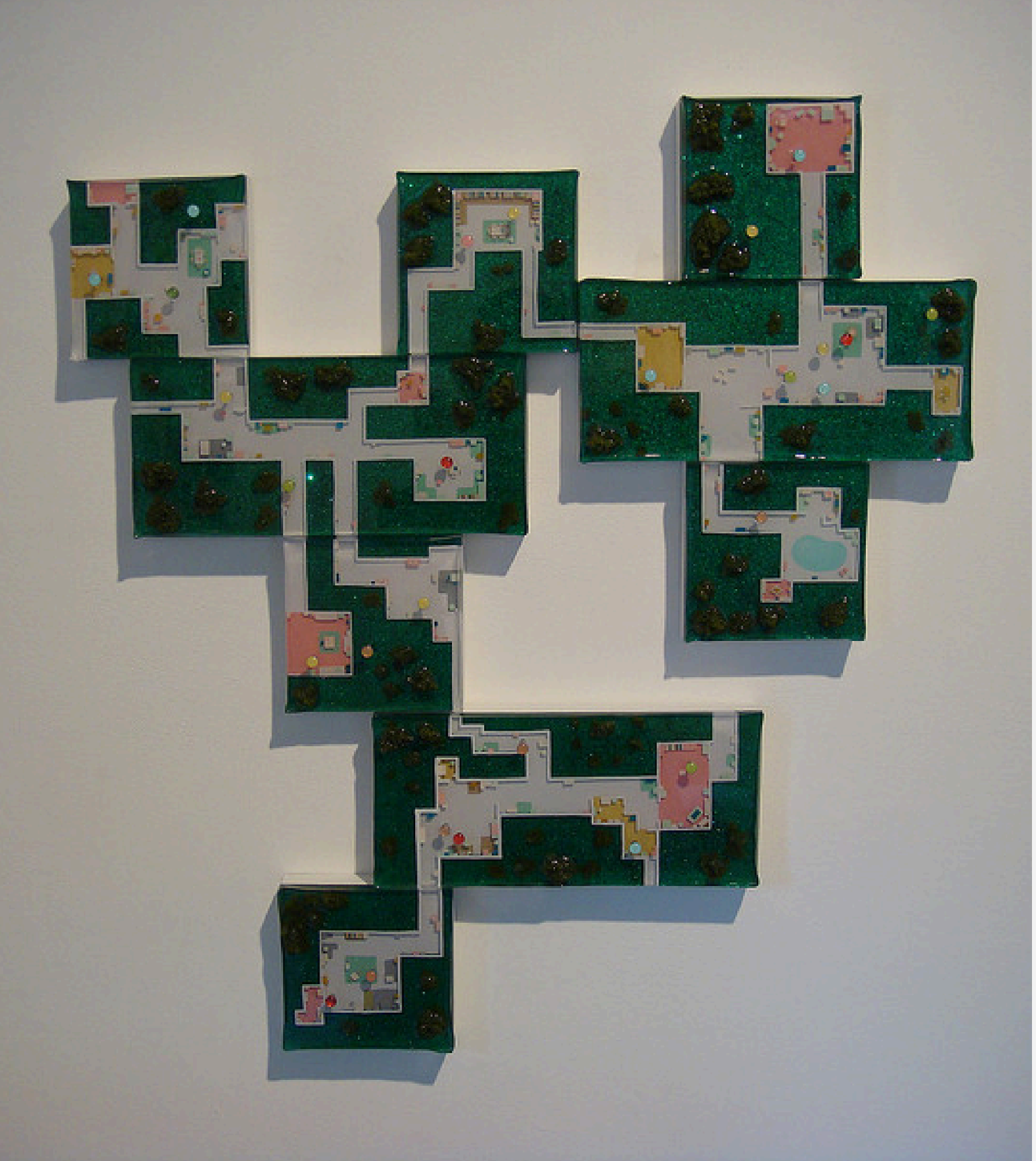


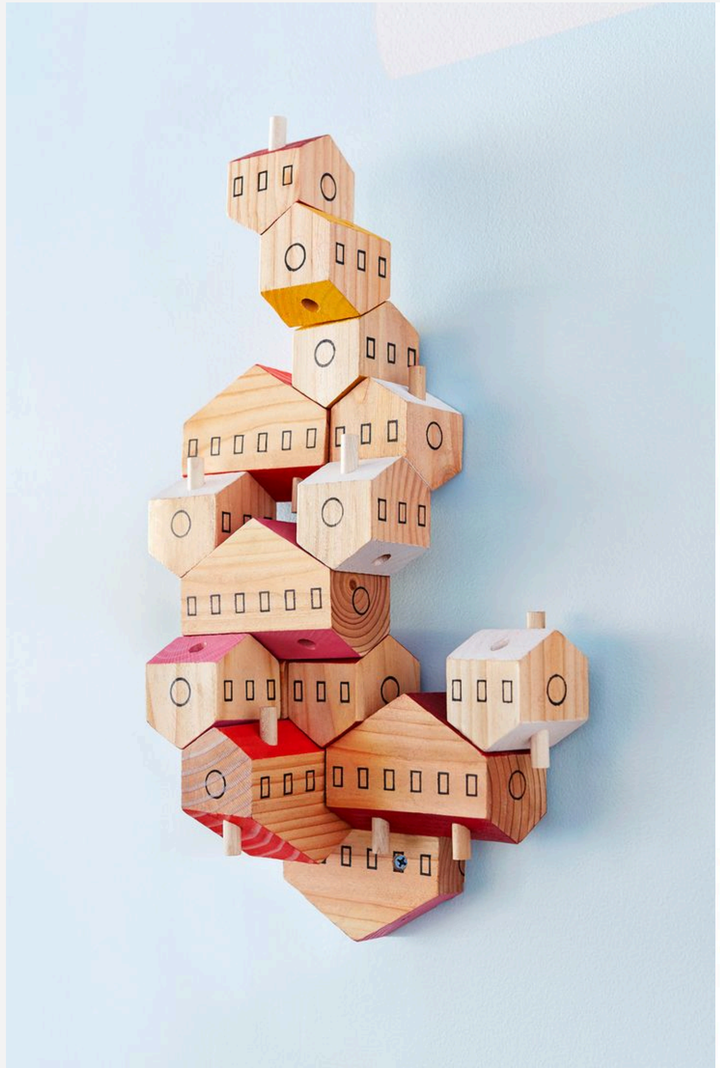
Can same location be used?

Same location can be used only if its distinguished with clear details.

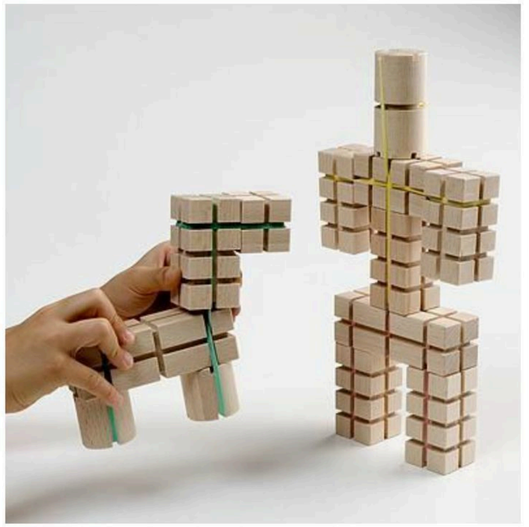
- Different themes
- Distinct imagery
- Avoiding sequential use
- Clearing & refreshing the palace
- Different starting points

References









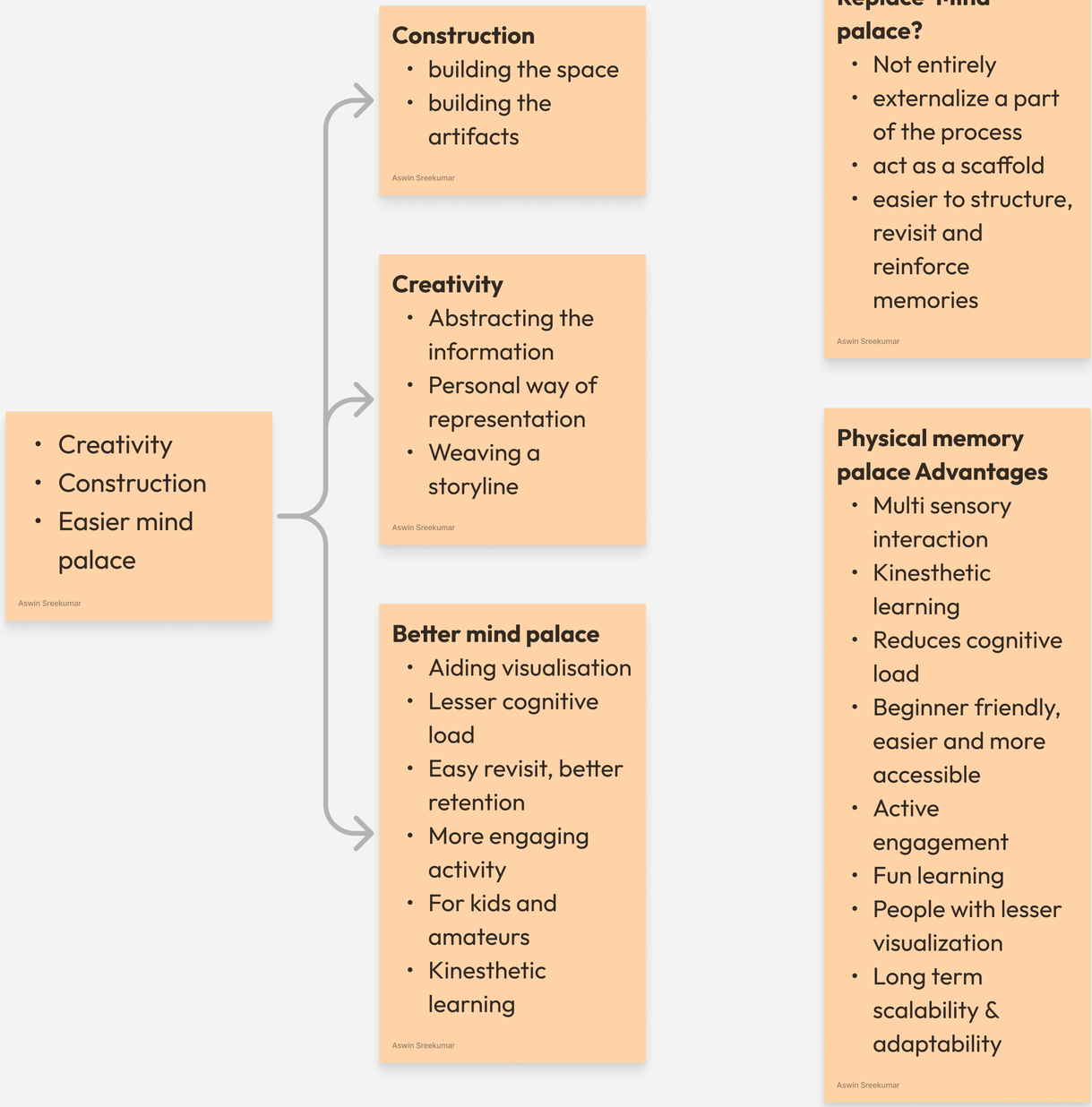




Synthesis

Mind Palace Challenges

- Regular revisits to keep in memory
- Revisit takes time and effort.
- More chances of error
- Strong visualisation skills required
- Similar to Rote Learning
- High cognitive load to learn
- Constant practice required
- Hard to scale or change over time
- Requires effort to maintain every detail



Design Brief

A Constructive Toy for Enhancing Memory & Learning Through Spatial Play

To design a constructive toy that make learning and memorizing information effective, creative, and fun by leveraging the memory palace technique in a tangible and interactive way. The toy should enable users to physically build and organize memory structures, making learning engaging, intuitive, and playful while fostering creativity.

Users:

Primary: Children, who are learning foundational concepts
(History, Science facts...)
Secondary: Parents, Educators

Experiments

Experiment 1

Understanding memory palace

Objective: Trying to understand memory palace.

Procedure:

- Participants are asked to visualise a location/space which they are familiar with. (room, home, hostel, office...)
- They are given the pre-set list of abstract words.
- They are asked to convert each words into ridiculous imagery.
- They are asked to travel through the sketch and place each images at each points through the journey. The journey should have a starting and ending.
- The process was carried out for all 15 objects.
- After this, they are asked to run through the final palace.
- Then they are sked to recite the list of words without looking at the output.

- Pickled garlic
- Paneer
- Salmon
- Six bottles of white wine
- Socks (x3)
- Three hula-hoops
- Save 5000rs
- Dry ice machine
- E-mail Sophia
- Cat suit
- Find Anurag Kashyap film—Bombay Velvet
- Submit Assignment 3
- Collect laundry
- Notebook and stickers
- Barometer

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Observation

- Participants were able to recite every object except 2 or 3, and some were out of order.
- Found the process very engaging.
- Requires visualisation skill but may not be helpful if otherwise.
- Was trying to find association with the things in the space.
- Travelled through each rooms to remember what all things were kept.
- Confusion occurs while reciting if there is back & forth in the path.
- Wishes if they could record this spatial mapping to revisit if forgets.
- Better than rote learning.
- Was not able to remember the list after several hours.

Experiment 2

Exploring memory palace through physical visualization

Objective: Trying to understand how different people visualise memory palace. Understanding how people convert words and imagined ideas into shapes. Understanding the process of abstraction.

Materials: Coloured papers (green, pink, yellow), glue, scissors, Notebook, pen

Procedure:

- Participants are asked to visualise a location/space which they are familiar with (room, home, hostel, office...).
- They are asked to sketch a plan of the space they visualised into the notebook. Plan could have adequate details to recognise each room. (sofa, chairs, bed, table, door, stairs...)
- They are given a pre-set list of abstract words.
- They are asked to visualise these words as objects/ artifacts .
- They are asked to travel through the space and place each object at each points through the journey. The journey should have a starting and ending.
- Same time they are asked to cut out shapes which represent the imagined objects and paste them at the specific points in the sketched plan as well.
- The process was carried out for all 15 objects.
- After this, they are asked to run through the final imagery.
- Then they are asked to recite the list of words without looking the output.

- Pickled garlic
- Paneer
- Salmon
- Six bottles of white wine
- Socks (x3)
- Three hula-hoops
- Save 5000rs
- Dry ice machine
- E-mail Sophia
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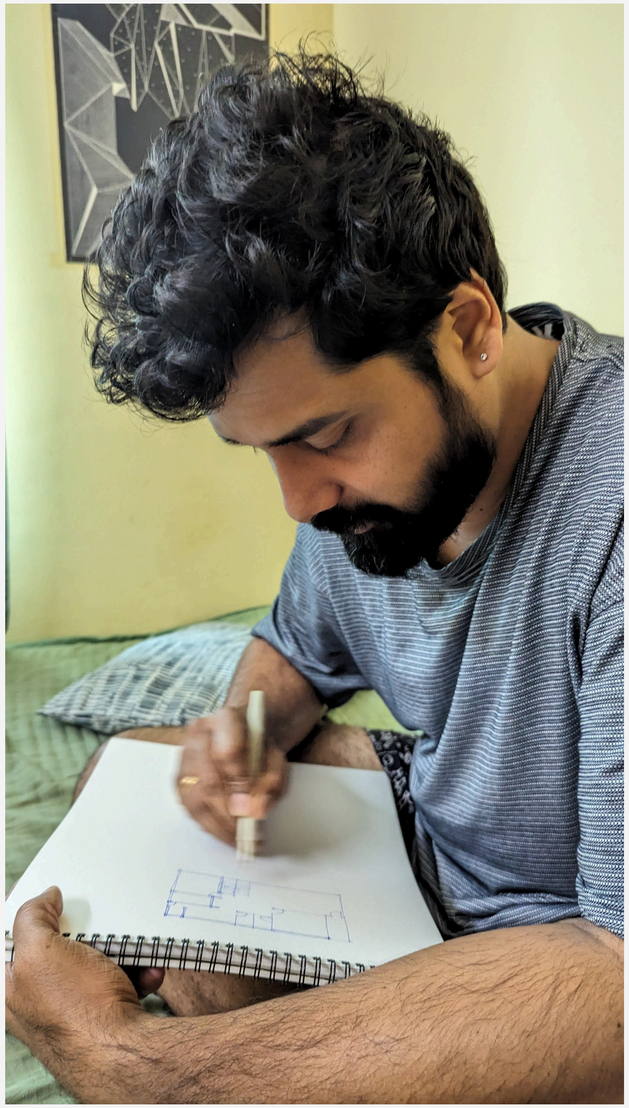
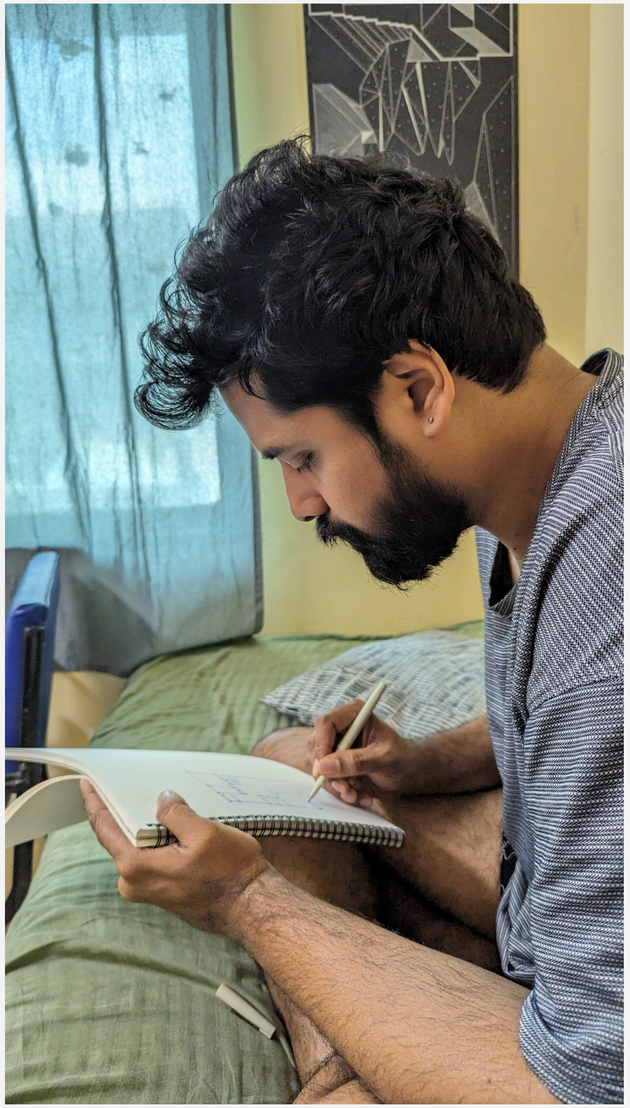
Participant 1







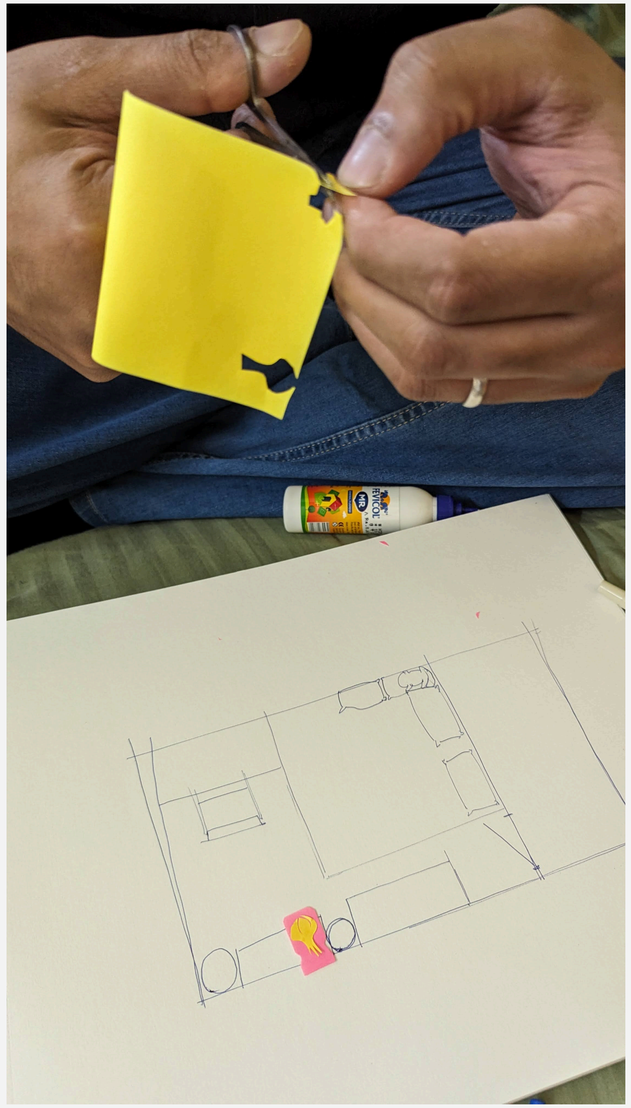


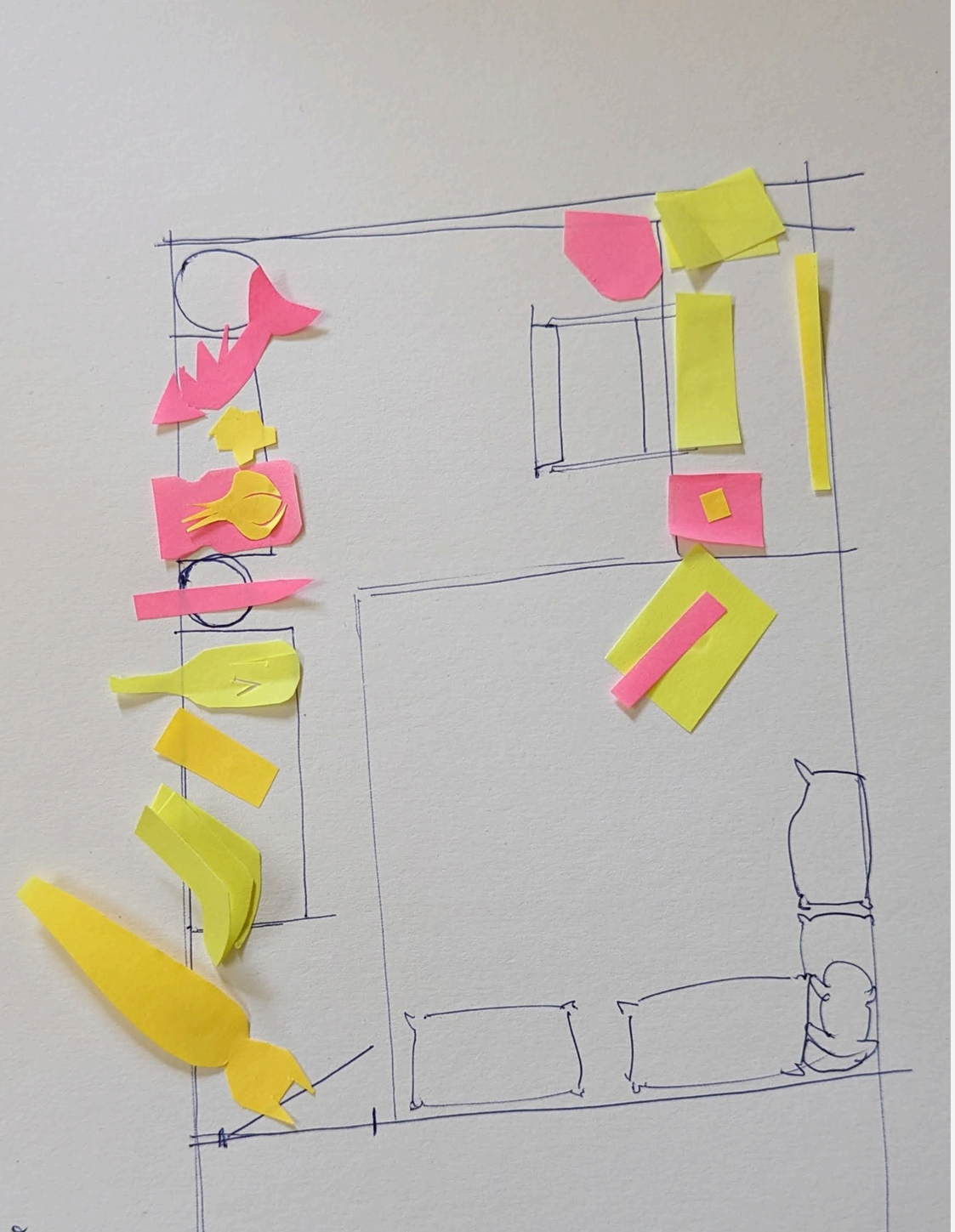
Observation

- Participant was able to recite every object mentioned.
- Only 1 object was out of order.
- Participants were amused to find out they could recite everything correctly.
- Did not use colour to the abstract and more into associating shapes.
- Were conscious that the technique was for memorising the list.
- Travelled through the space mentally to remember and recite.
- Tried to associate the artifacts to their habits and things present in the space.
- They were building a storyline throughout the process.
- Confusion occurs when there is a loop or back & forth in the path they are following
- Found the process engaging.

Participant 2







Observation

- Participant was able to recite every object mentioned.
- Only 1 object was out of order.
- Participants were amused to find out they could recite everything correctly.
- Participant tried to differentiate objects with colours.
- Participant tried to bring 3rd dimension to the object. Better if the space plan had 3rd dimension.
- Were conscious that the technique was for memorising the list.
- Travelled through the space mentally to remember and recite.
- Tried to associate the artifacts to their habits and things present in the space.
- They were building a storyline throughout the process.
- Confusion occurs when there is a loop or back & forth in the path they are following
- Believes they will forget it after sometime, while actually was able to remember even after days without revisiting.

Experiment 3

Exploring memorising capability through creative abstraction.

Objective: Trying to understand how different people abstract words/phrases into tangible forms. Exploring multisensory approach in memorising.

Materials: Play dough (red, blue, green, yellow, white, orange, pink, purple), Notebook, pen

Procedure:

- Participants should not be aware of the objective/ output of the experiment.
- Participants are asked to sketch a plan of a location/space which they are familiar with on the notebook. (room, home, hostel, office...)
- Plan could have adequate details to recognise each room. (sofa, chairs, bed, table, door, stairs...)
- They are given the pre-set list of abstract words.
- They are asked to convert each words into abstract forms using the play dough which could be recognisable by them.
- They are asked to travel through the sketch and place each form at each points through the journey. The journey should have a starting and ending.
- The process was carried out for all 15 objects.
- After this, they are asked to run through the final output.
- Then they are asked to recite the list of words without looking at the output.

- Pickled garlic
- Paneer
- Salmon
- Six bottles of white wine
- Socks (x3)
- Three hula-hoops
- Save 5000rs
- Dry ice machine
- E-mail Sophia
- Cat suit
- Find Anurag Kashyap film—Bombay Velvet
- Submit Assignment 3
- Collect laundry
- Notebook and stickers
- Barometer

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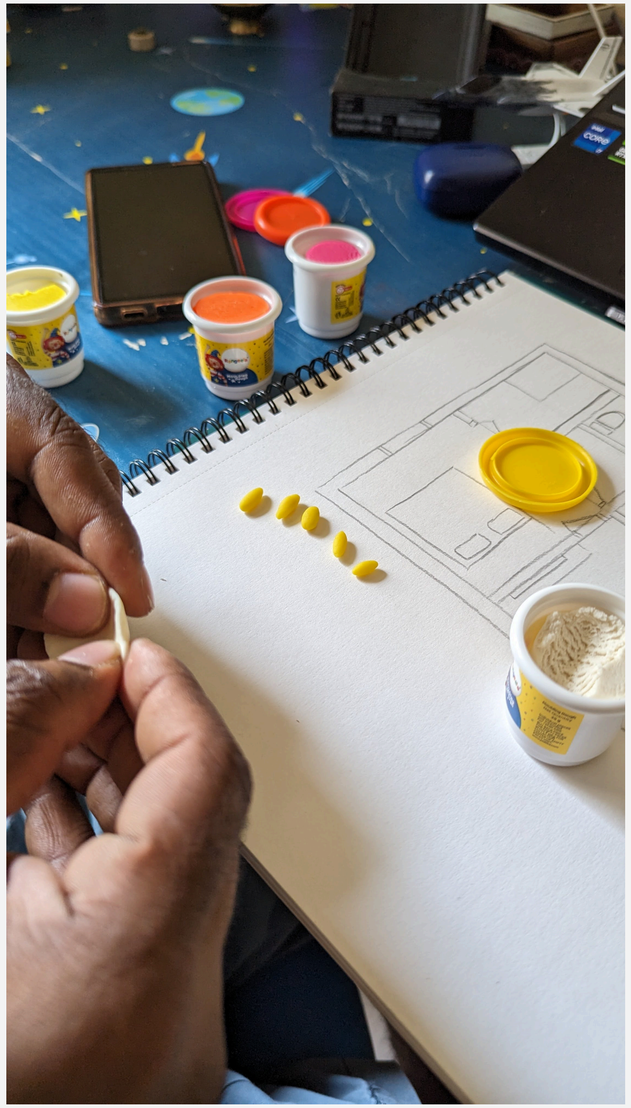
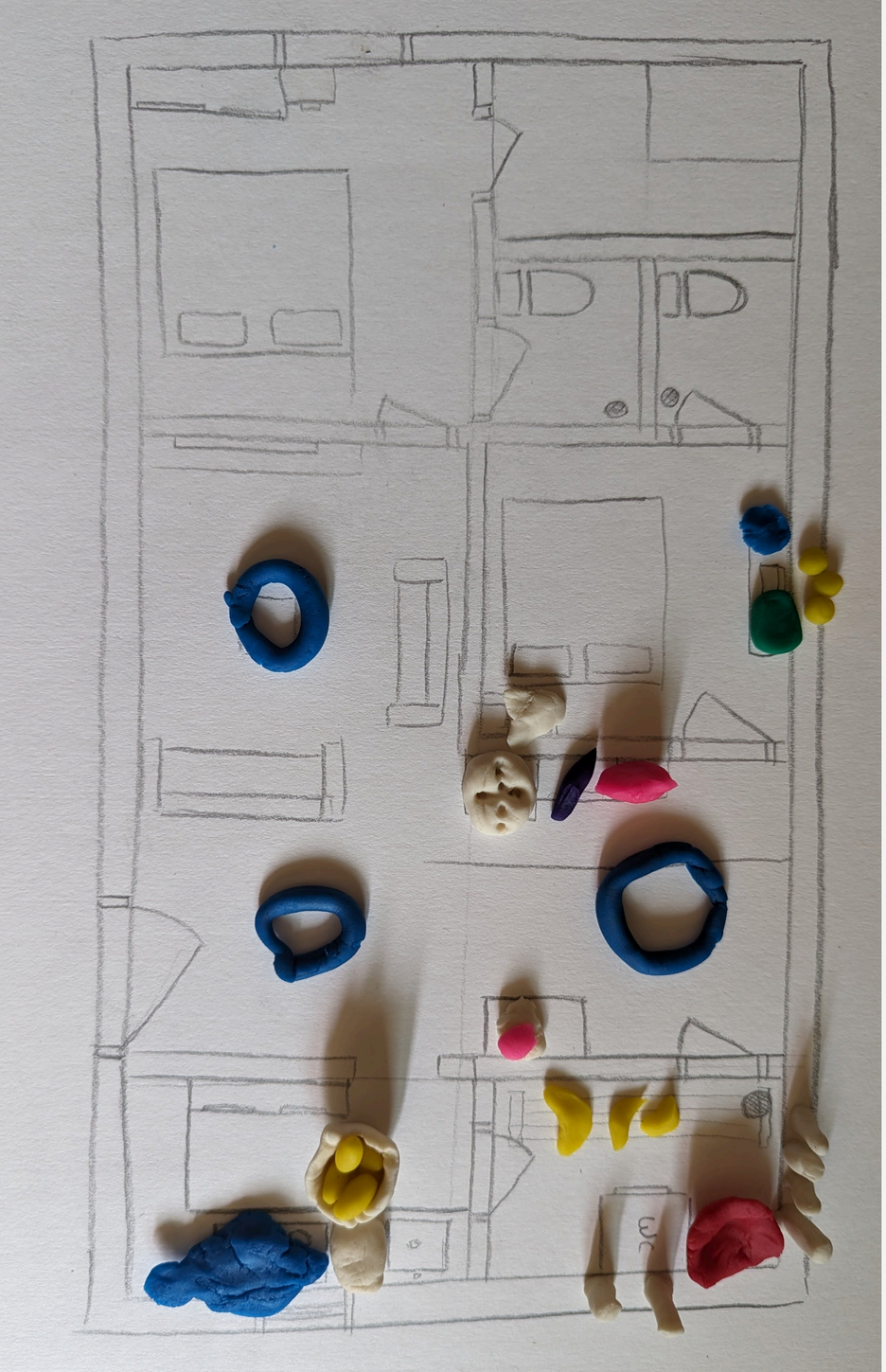
Participant 3





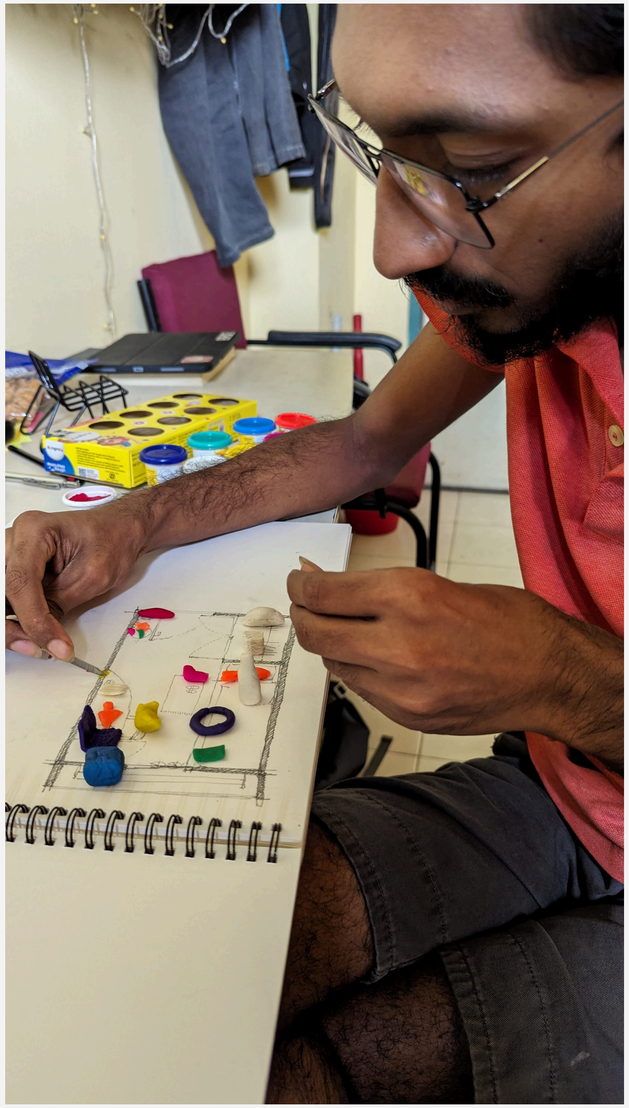




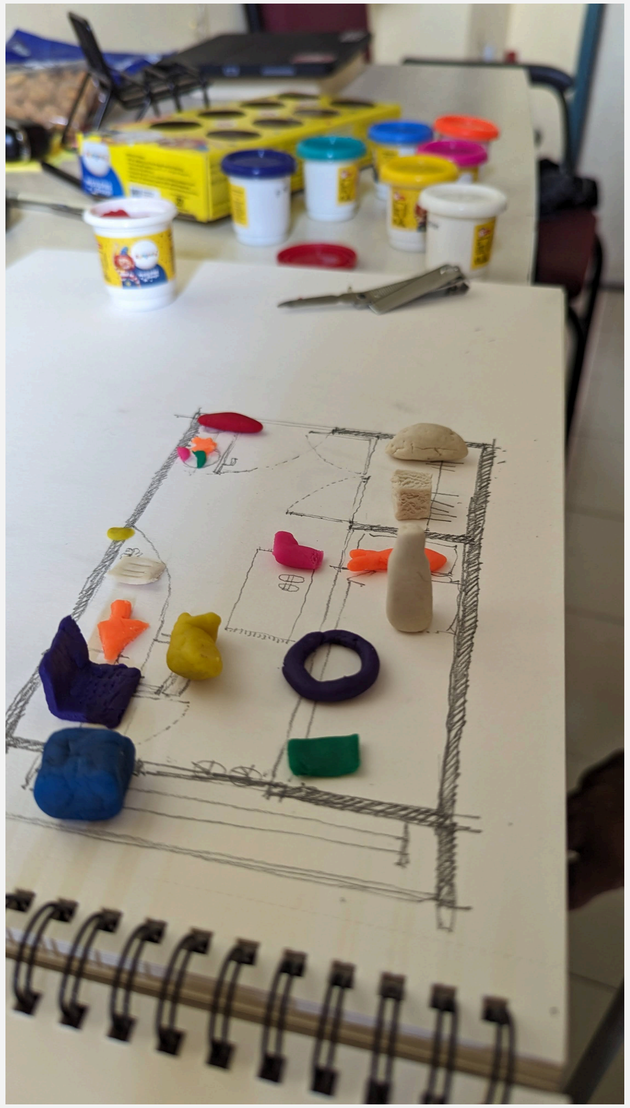
Observation

- Participant was able to recite every object except 1.
- Found the process very engaging and fun.
- Was trying to find association with the things in the space.
- Used all the colours provided to achieve abstraction.
- Used simple forms to abstract the words.
- Travelled through each rooms to remember what all things were kept.
- Believes he can create a storyline for the layout.
- Confusion occurs while reciting if there is back & forth in the path.

Participant 4









Observation

- Participant was able to recite every object in correct order.
- Found the process very engaging initially.
- Did not find a need to remember the list.
- Sceptical about the process.
- Believes he will forget it after sometime, while actually was able to remember even after days without revisiting.

Experiment 4

Understanding tangible abstraction.

Objective: Trying understand how people convert words/phrases into tangible forms with limited options.

Materials: Play dough (red, blue, green, yellow, white, orange, pink, purple)

Procedure:

- Participants are given a list of words or phrases.
- They are provided with set of form options which they could choose. (cuboid, sphere, frustum, small sphere, cylindrical disk, long tube, rectangular plate)
- They are then asked to abstract these words/phrases into tangible forms by combining, mixing and matching these set of options.
- This is carried out one by one for the whole list.

- Pickled garlic
- Paneer
- Salmon
- Socks (x3)
- Save 5000rs
- E-mail Sophia
- Cat suit
- Find Anurag Kashyap film—Bombay Velvet
- Hitler's pact with Stalin
- Independence declared
- George Washington
- Odisha

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Participant 5

Observation

- Participant was able to create forms for all words with the number of options.
- Manipulated the shapes due to play dough's properties.
- Manipulation of sizes was done.
- Found the task engaging
- Believes 'cone' shape would be a good addition.

Nb:

- Tried to memorise and recite the list immediately.
- Felt some difficulty but remembered all.
- Recollected by thinking of the arrangement of the forms kept by the participant.



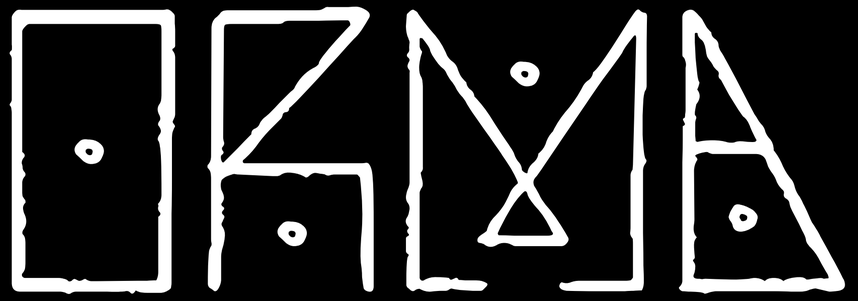
Participant 2

Observation

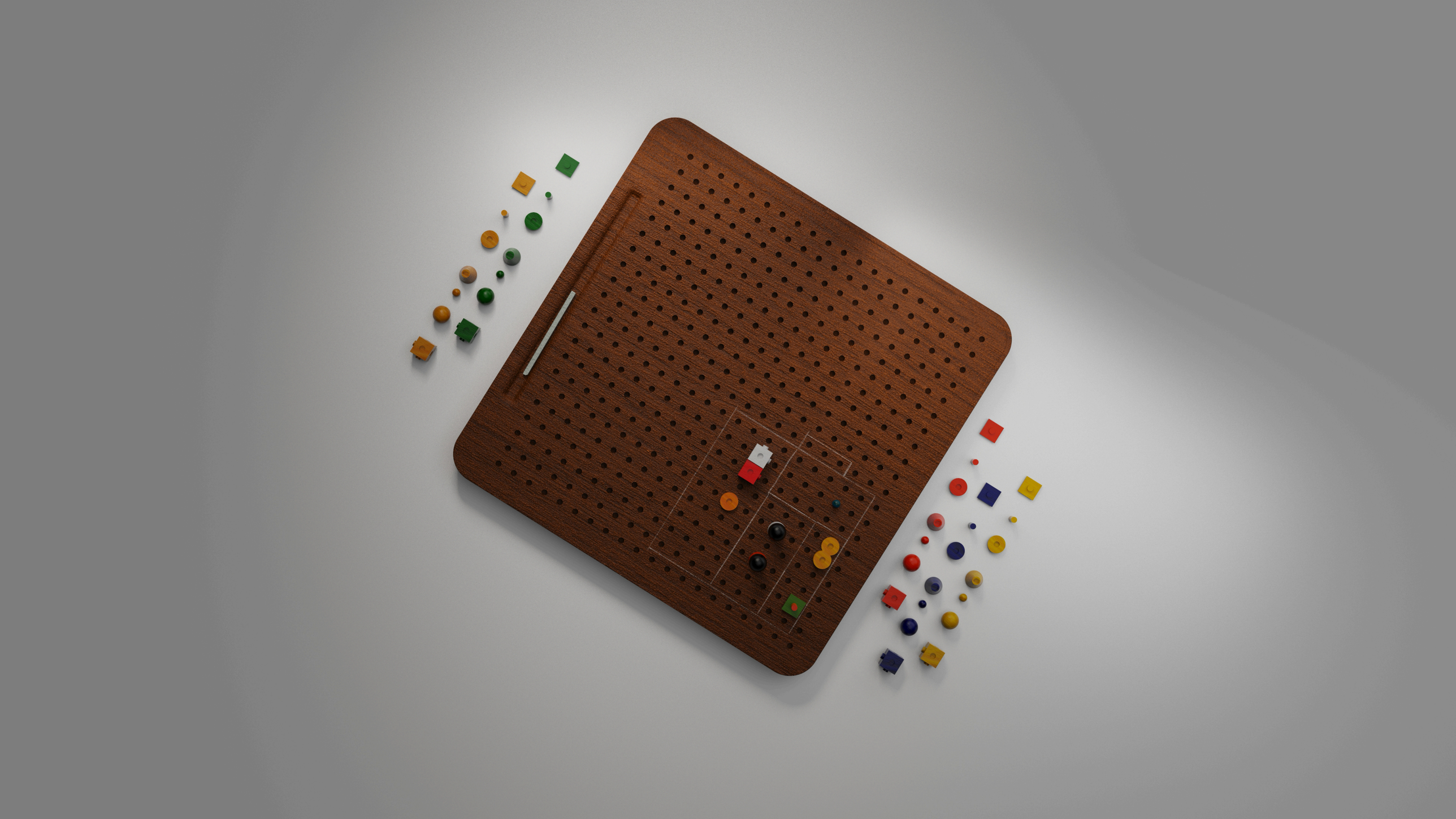
- Manipulation of sizes and shapes was restricted.
- Participant was able to create forms for all words with the number of options.
- Found the task engaging
- Believes ‘cube’ shape would be a good addition.
- Frustum needed to make human figures.

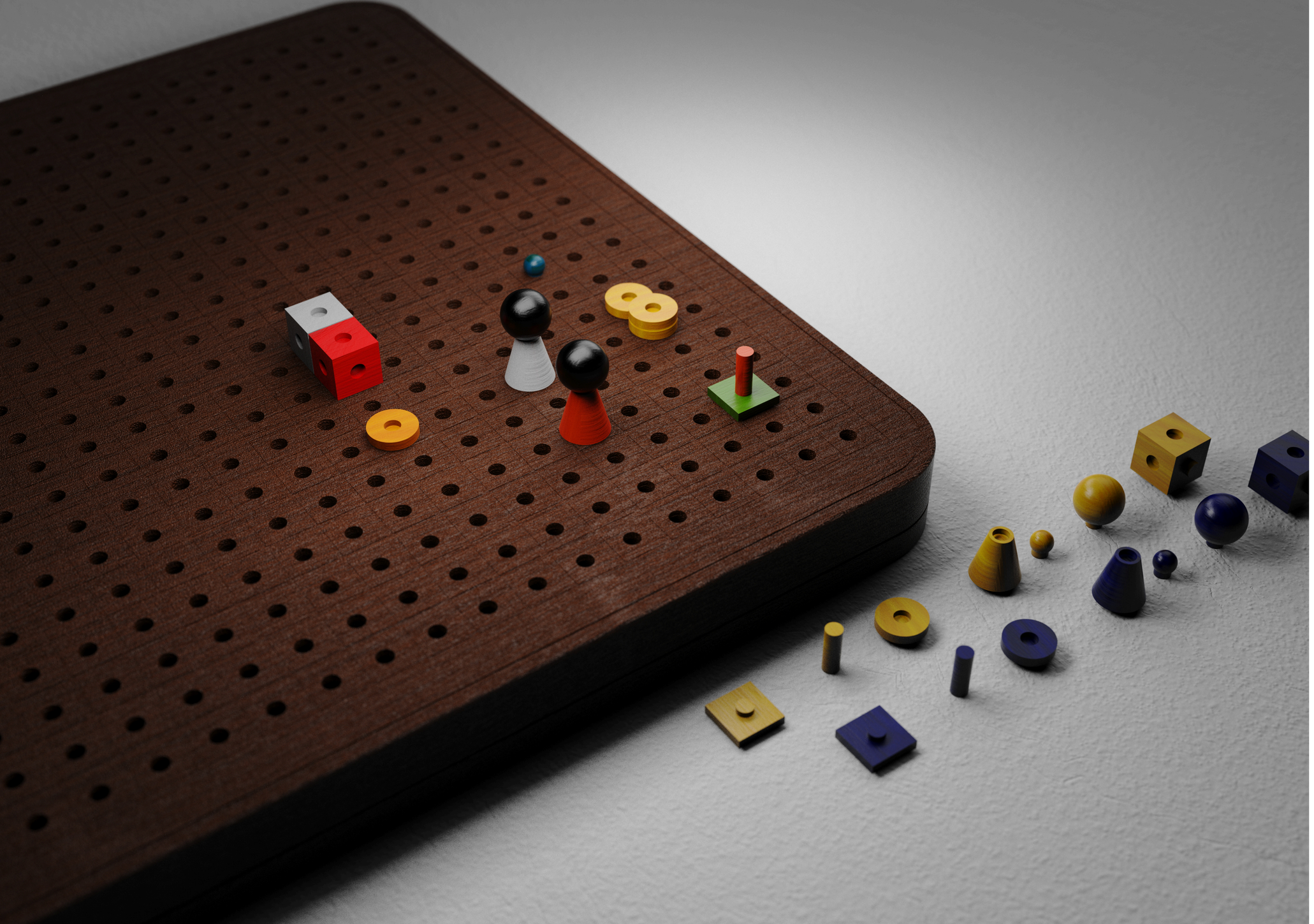
Insights

- Users are able to abstract with the limited number of shapes.
- Memorization becomes strong when lesser replication of original word; more creative, more absurd
- Positioning is of very importance for memorising.
- Path development should be linear to avoid confusion in memorising.
- Path constraint needs to be maintained.



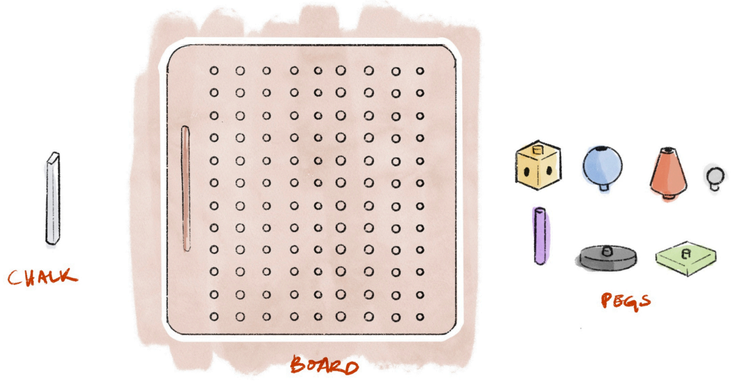
Build your Memory.
Shape your Imagination.

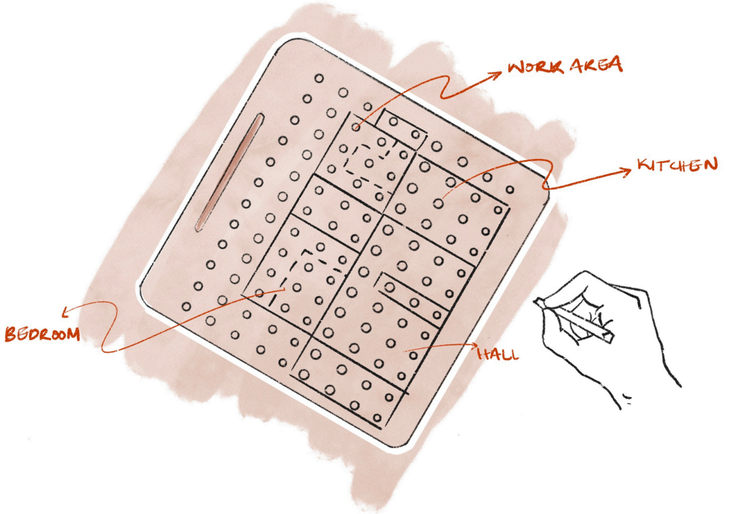


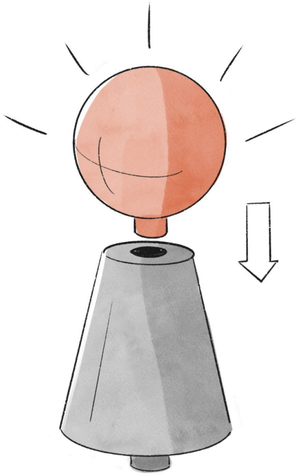


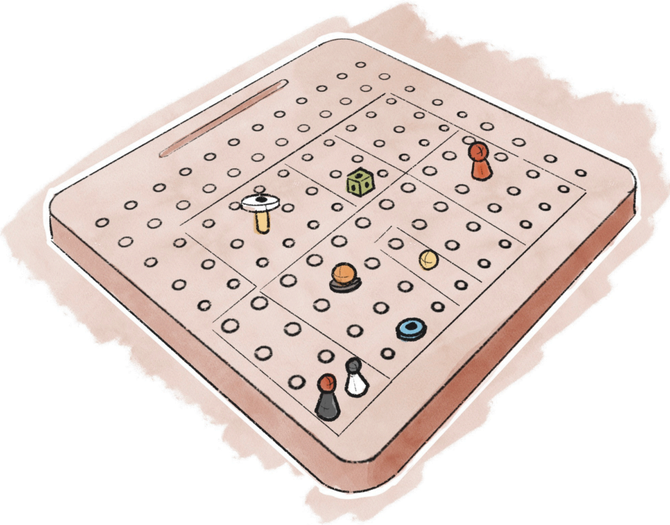
How to play:

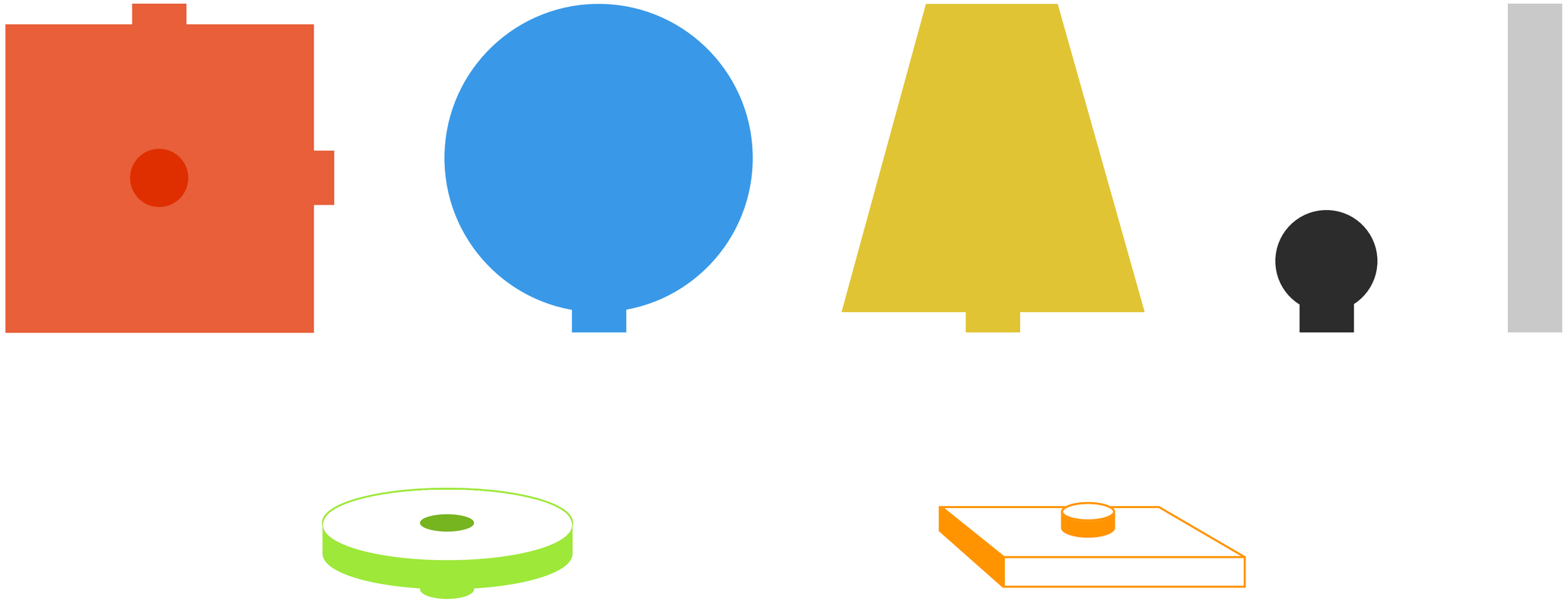
- Think of a location you know well — your home, school, a park, or even an imaginary world. This will become your memory palace.
- Use the wooden board and chalk provided to draw your palace layout. The etched grid lines help you keep your plan neat and proportional.
- Imagine a route you would walk through the space — this path helps you sequence your memories.
- Use the shaped pegs to represent ideas, events, or things you want to remember. Combine pegs creatively to form objects or scenes that symbolize each memory or idea. The more vivid and meaningful the form, the easier it is to remember.
- Place each peg into the holes on the board, following your imagined path.











Better creativity with limited options.



Human



Umbrella



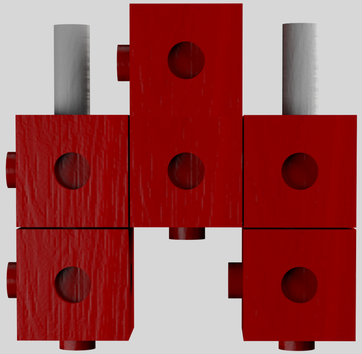
Cheese block



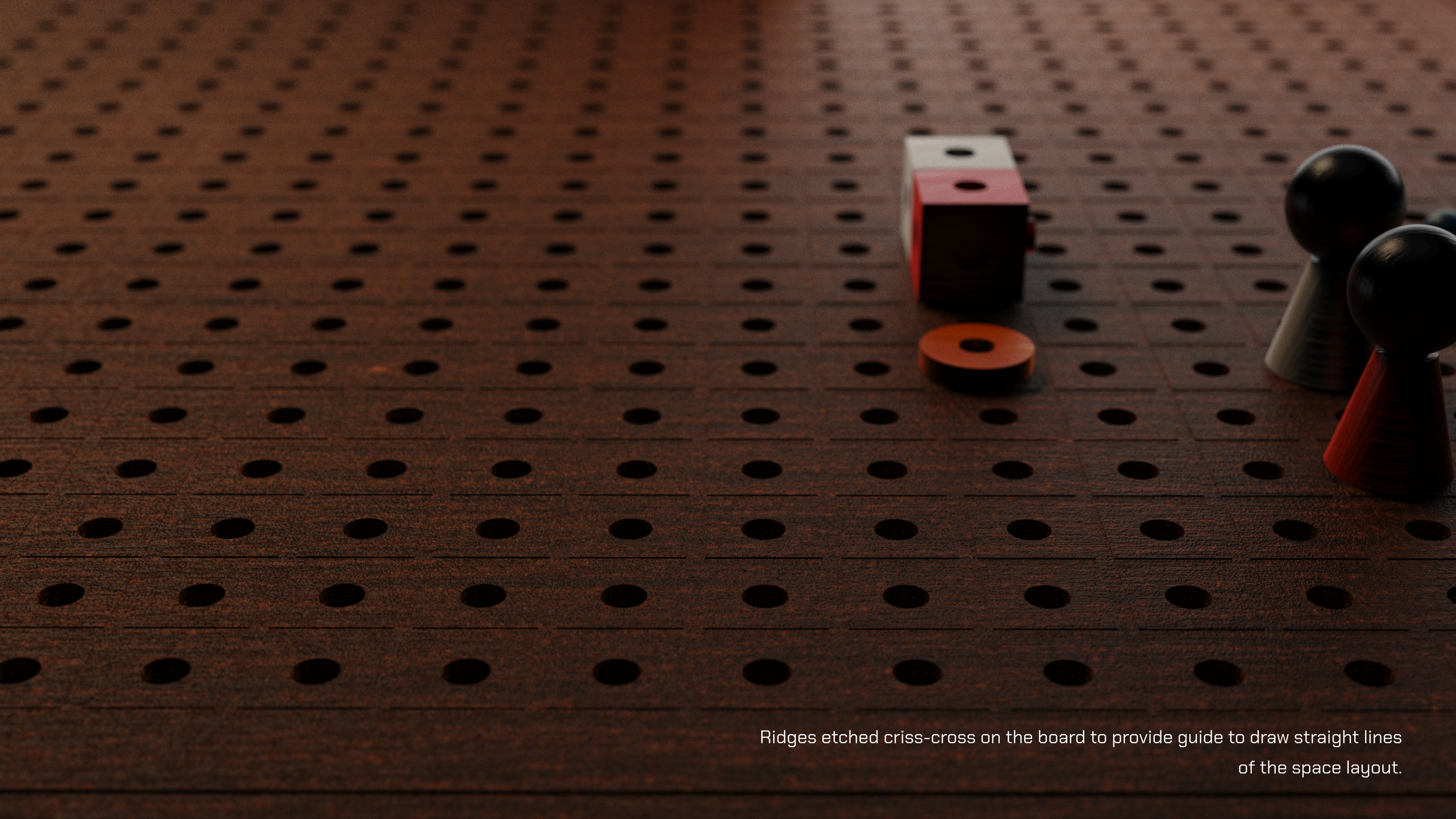
Explosion



Salmon

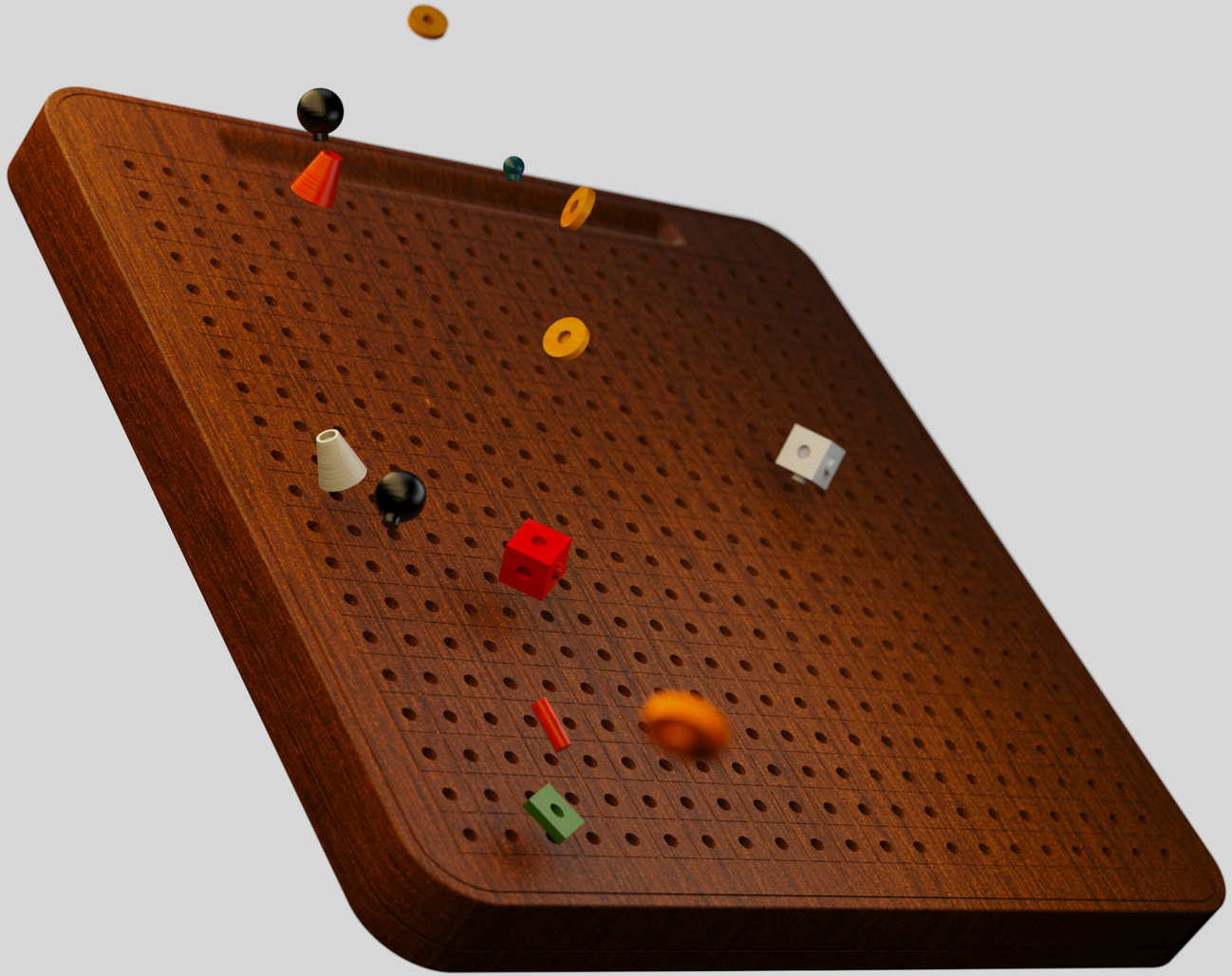


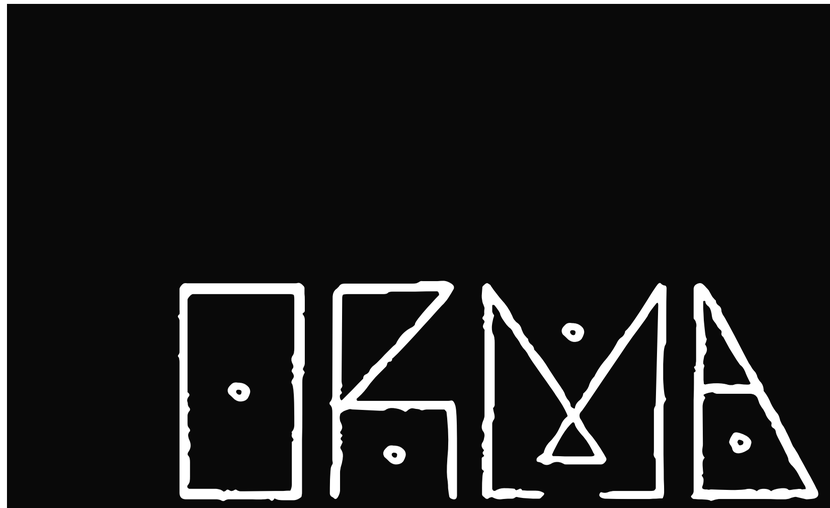
Bombay velvet



Ridges etched criss-cross on the board to provide guide to draw straight lines of the space layout.

Laying out location in 2 dimension reduces cognitive load in user.





Build your Memory.

Shape your Imagination.

#596D88

#AC0A08

#FF4C00

#C78048

ORMA

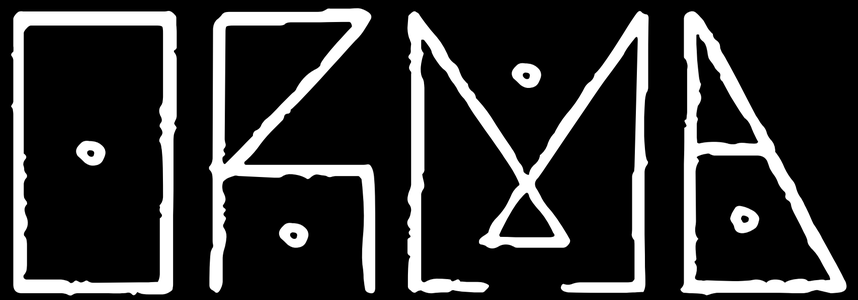
Transform your thoughts into tangible worlds. Inspired by the ancient method of loci and fuelled by modern imagination, ORMA lets you construct, connect, and remember like never before.

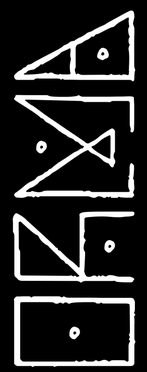
Craft intricate structures, assign them meanings, and explore the limitless landscapes of your own mind. Whether you're training your memory, telling a story, or simply building your mind palace, ORMA empowers you to create a world that's entirely your own.

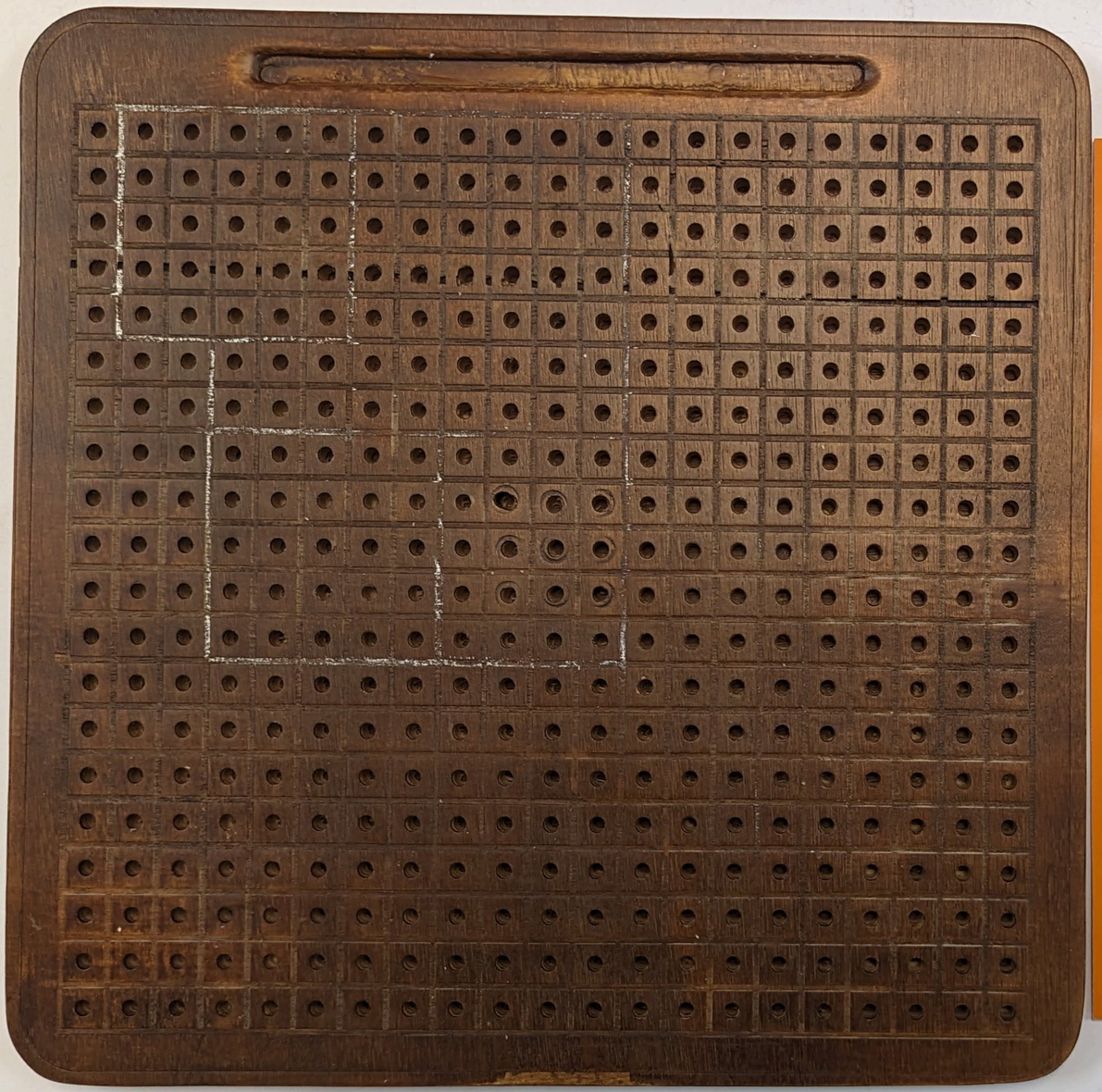
BUILD.

IMAGINE.

REMEMBER.







Build your Memory. Shape your Imagination.

ORMA is a constructive toy designed to help you visualize and remember information by building your own mind palace — a mental space where each structure represents a memory, an idea, or a story.
Use the pieces not just to build objects, but to build meaning.

How to Play:

Think of a location you know well — your home, school, a park, or even an imaginary world. This will become your memory palace.

Use the wooden board and chalk provided to draw your palace layout. The etched grid lines help you keep your plan neat and proportional.

Imagine a route you would walk through the space — this path helps you sequence your memories.

Use the shaped pegs to represent ideas, events, or things you want to remember. Combine pegs creatively to form objects or scenes that symbolize each memory or idea. The more vivid and meaningful the form, the easier it is to remember.

Place each peg into the holes on the board, following your imagined path.

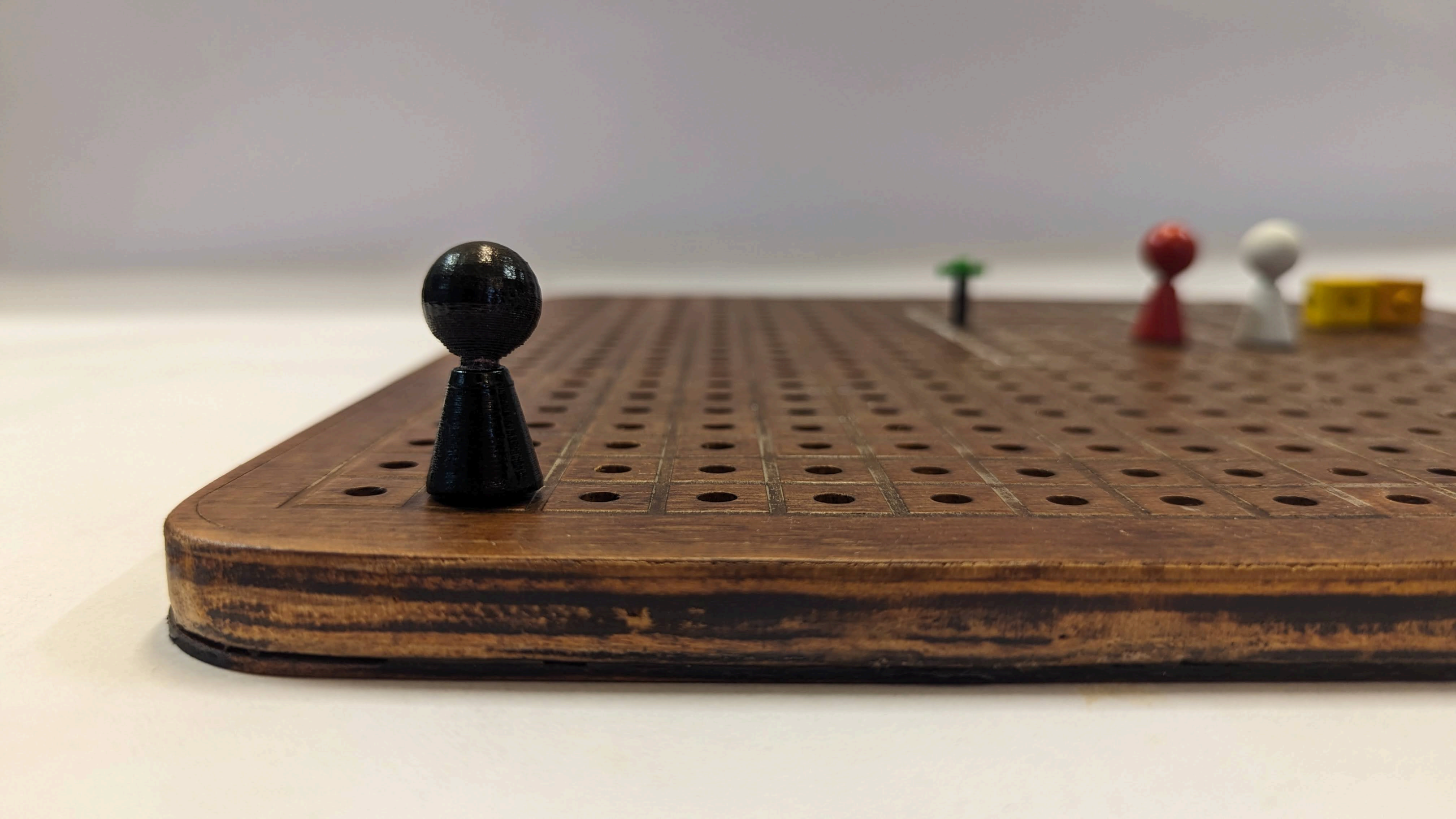
Note:

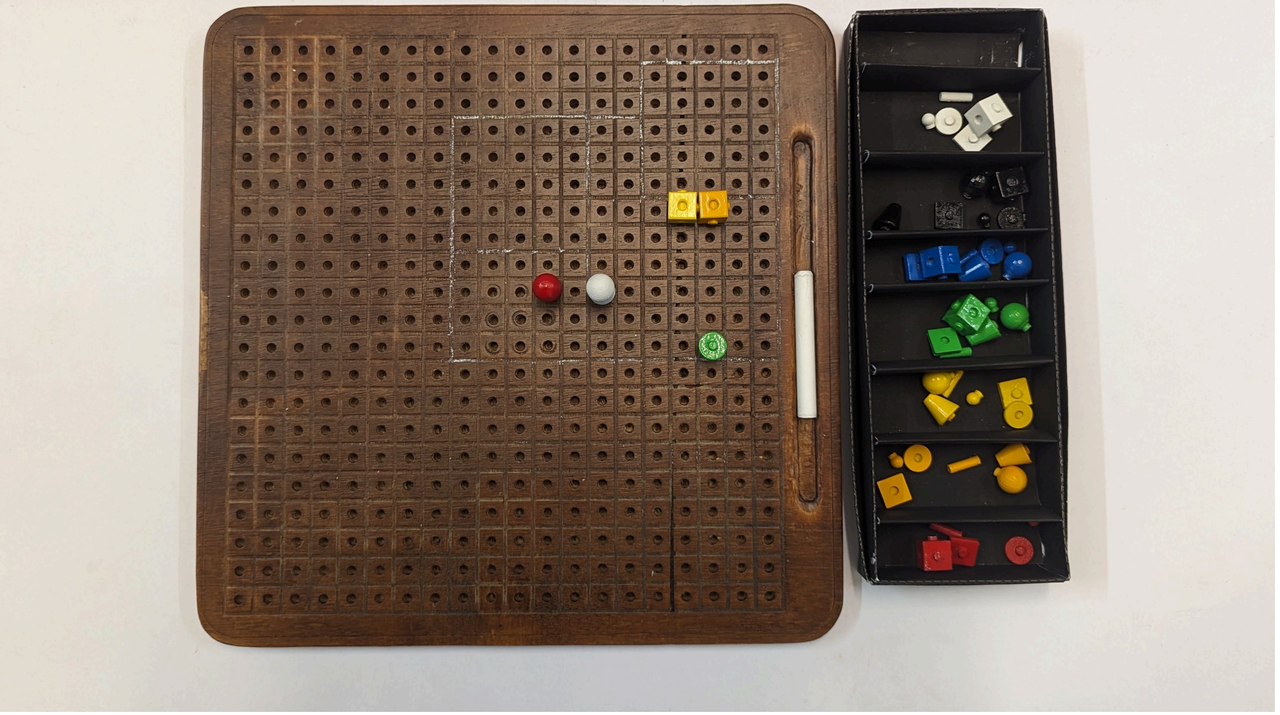
Try recalling your list by mentally walking through your palace to reinforce.

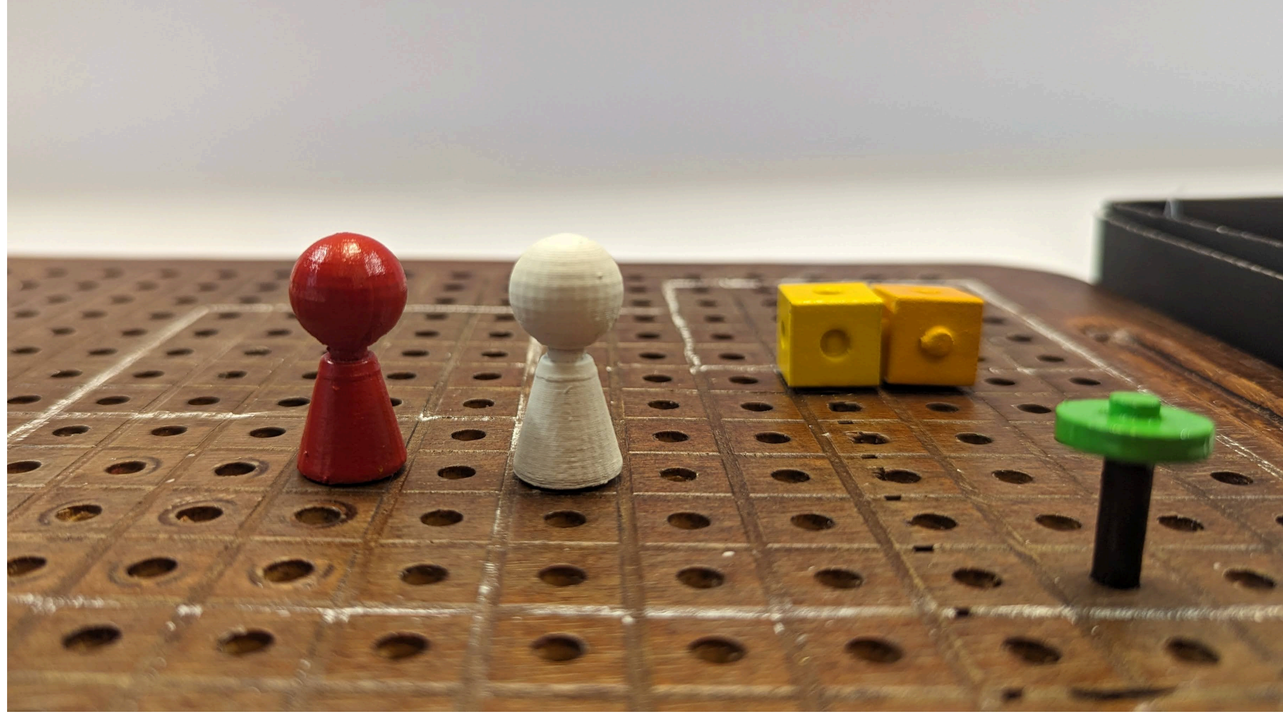
Revisit and rebuild different palaces to store more memories.

Each time you use ORMA, you train your brain to remember better.











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BUILD.
IMAGINE.
REMEMBER.
ORMA
ORMA

Exploring Constructive Toys

Constructive toy for enhancing memory & learning through spatial play

Student name - Aswin S

Guide name - Prof. Ravi Poovaiah

About the Project

Memorization is a key part of learning, yet traditional methods like rote learning and flashcards often feel repetitive and ineffective. This research explores the idea of a "Constructive Toy Tool for Memorization"—a hands-on product that helps children learn using the memory palace technique in a tangible way.

The project examines how physical interaction and spatial organization can support memorization by allowing children to construct and arrange memory structures rather than relying entirely on mental visualization. It investigates whether spatial learning and object placement can serve as effective aids for encoding and recalling information, similar to how mnemonic imagery is used in the traditional memory palace method.

The study involved observing how people interact with hands-on activities and assessing whether constructing physical memory spaces enhances retention. Participants were given different sets of information and tasked with memorizing them using both conventional methods and the proposed system. Their ability to recall information was then evaluated over time. Insights gained from the study revealed patterns in spatial memory encoding, which were categorized based on recall accuracy, engagement levels, and creative adaptability. These findings form the basis for developing a more effective, play-based learning tool that transforms memorization into an interactive, enjoyable, and intuitive experience.

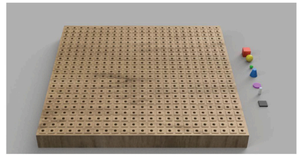
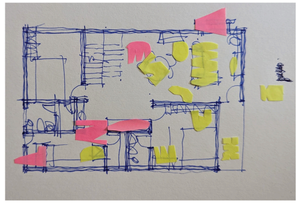
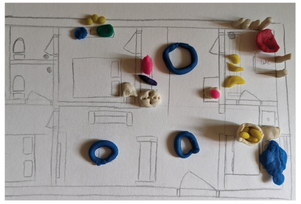


Fig. 1. Conceptual image of the final product

Exploration Outcome

Physically constructing memory structures helped participants engage more deeply with the information, making recall more intuitive. They found it easier to associate concepts with spatial and tactile elements, reducing cognitive load.





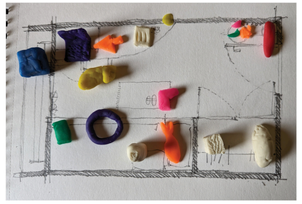


Fig. 2. Experiment outcomes

Methodology

1) Participants

The study involved multiple participants with varying levels of experience in memory techniques. Participants were selected based on their willingness to engage in exploratory experiments related to visualization, abstraction, and memorization techniques. The selected group had good visualization skills and spatial understanding. They were not given prior training in the memory palace technique to ensure unbiased observations.

2) Experiment Procedure

The research was conducted through a series of four experiments, each designed to investigate different aspects of the memory palace technique and tangible abstraction.

Experiment 1: Understanding Memory Palace
Participants were asked to visualize a familiar space. They received a pre-set list of abstract words and were instructed to create ridiculous mental imagery for each word. They then placed these imagined objects at specific points in their visualized space, forming a journey with a defined start and endpoint. Finally, they recited the words from memory without referring to any notes.
Experiment 2: Exploring Memory Palace Through Physical Visualization. Participants followed a similar process as in Exp 1 but sketched a floor plan of their imagined space.
They cut out shapes from colored paper to represent abstract words and placed them on the corresponding locations in their drawn plan. The physical visualization aimed to reinforce recall by integrating spatial and visual cues.
Experiment 3: Exploring Memorization Capability Through Creative Abstraction. Participants sculpted the list using playdough instead of paper cutouts. The focus was on tangible abstraction, exploring how participants converted words into physical forms that they could later recall. The playdough forms were placed in the drawn plan, following the same structured journey as in previous experiments.

Experiment 4: Understanding Tangible Abstraction. Participants were given a limited set of predefined forms and asked to abstract the list into physical forms by manipulating these options. This experiment aimed to study the effect of restricted design choices on the abstraction process and memorization.

3) Outcome

In all experiments, participants successfully recalled most of the objects, with negligible errors. Tangible visualization improved recall accuracy compared to purely mental visualization. Participants found the process engaging and reinforcing the idea of tangible memorization. The introduction of color & form played a role in differentiating and structuring the memory journey.

4) Discussion

The findings suggest that the multi-sensory approach in visualizing memory enhances recall, making memorization more engaging and structured. Participants remembered more details for longer periods when they had physical representations While spatial mapping aids memory organization, confusion arises when sequences are unclear or paths involve loops. The abstraction of the words through forms, colours or even stories boosted creativity, while the tangible construction helped motor skills.

5) Design Direction

Building on these insights, the project aims to develop a constructive memory tool that integrates spatial, visual, and tactile learning. A constructive toy with interactive 3D mapping could be developed to enhance recall, while customizable physical components would allow users to create personalized memory structures. Since, the technique works with spatial mapping, focusing more on the construction and abstraction modules helps. Sketching the plan of the space insted of building will reduce the cognitive load even more. The design should incorporate construction methods like, snap fit, slot-based organization, customizable pieces to adapt to different users.



Fig. 3. Participant working with playdough to create multiple forms as part of Experiment 3

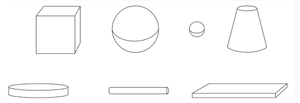


Fig. 4. Form constraints provided during Experiment 4

THANK YOU