

**Memorology: Multi-sensory TangiBalls Game for
Patients with Dementia**

MIMS Capstone - Final Paper

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Introduction

Background

6.2 million Americans over 65 years old are living with dementia in 2021, and this number is projected to double to 12.7 million in the next 20 years (Alzheimer Association, 2021). In addition to causing mental and physical decline, dementia is one of the conditions that are “most affected by loneliness and social isolation” (Curelaru et al., 2021). This can be due in part to stigmatization and breakdown of communication that drives an increasing relationship rift between loved ones and dementia patients as the latter experience cognitive impairment and loss of independence as their disease progresses (Katarzyna et al., 2015). Yet, such decreased to nonexistent social ties only compound the challenges for dementia patients as social isolation is a “well-known risk factor” for a variety of other life-threatening illnesses like “cardiovascular disease, functional decline, and depression” among others (Curelaru et al., 2021).

Additionally, treatment options in this area of patient well-being are limited because the focus tends to be either on pharmacological approaches that treat the physical symptoms only or the everyday logistics and demands of caregiving that place a strain on the caregiver-patient relationship (Stroka, 2021). This leaves a gap in interventions, specifically psychosocial ones, that seek to improve a patient’s quality of life and social connection with their community. With our project’s focus on the patient’s quality of life, we analyze the existing psychosocial approaches and conduct user research in a breadth of settings to identify gaps in current dementia treatments so that we can design a solution in that area.

Our Solution

Thus, the **Memorology** project focuses on the aspect of the patient’s emotional well-being by providing relaxed and fun opportunities to socialize and bond with family and friends. Memorology utilizes multi-sensory tangible user interfaces, TangiBalls, in conjunction with gamification to engage both patients and their social networks via a shared reminiscence activity (i.e., events, places, people, feelings, milestones).

Target User

Our board game is intended for people living with dementia to play together with their caregivers and loved ones. Thus, we have two major user groups:

1. **People living with dementia:** Dementia is a general term for many diseases that impair patients' ability to remember, think, or make decisions. The different diseases impair patients' cognitive ability in different ways. We focused our major design decisions around the needs and pain points of early-stage Alzheimers' patients. Alzheimer's disease is the most common type of dementia (Centers for Disease Control and Prevention, 2019). Early-stage Alzheimer's patients experience impairment in their short-term memory, but they can still recall memories from the past and would benefit from the reminiscence experience. (See [Expert Interview Takeaway](#) section for further discussion.)
2. **Caregivers and loved ones:** These are people in the dementia patient's support network. Caregivers include patients' family caregivers that support the patient in a home setting as well as caregivers at professional senior care facilities. Loved ones include family members, partners, and friends.

Iterative Design

Our project design was refined via incremental discovery and design improvements that allowed us to fit the solution closer to the user's needs. The journey we undertook can be grouped into the following stages:

- **Literature Review:** To understand the existing interventions and gaps or limitations in existing dementia care. This guided us to understand themes our solution can address and combine.
- **Concept Exploration:** To brainstorm and ideate on how we can leverage Tangible UI and Gamification concepts in innovative ways.

- **User Research:** To validate and modify our idea and general project direction as backed by our users' inputs.

Literature Review

Dementia has no cure, however, there exist interventions (both with and without the use of pharmaceuticals) that help improve a dementia patient's quality of life. Specifically, our focus was on the non-pharmacological aspect of treatment. For example, major government organizations like Alzheimers.gov mention the importance of accommodating "changes in communication and behavior" after the onset of dementia (National Institutes of Health, 2022). Additionally, it emphasizes the benefits of an active and healthy lifestyle which can be helped by making "activity more fun" and matching "activity to what the person can do" (National Institutes of Health, 2022).

In fact, multiple studies have been conducted to evaluate the effectiveness of using a pharmacological only vs. a combined pharmacological and therapy approach (National Collaborating Centre for Mental Health, 2007). Studies by Chapman et al. (2004), Onder et al. (2005), and Bottino et al. (2005) separately evaluated the two options by assigning participants on medication only to a control group and participants on medication + therapy to a treatment group, and then at the end of the study period (max period was 6 months), tested all participants on the Mini Mental State Examination. MMSE for short, this exam contains a set of questions that measure cognitive impairment that is used in clinical and research settings primarily (National Library of Medicine, 2005). All studies referenced found a statistically significant benefit from combined treatment as demonstrated by MMSE scores across study participants (Chapman et al., 2004; Onder et al., 2005; Bottino et al., 2005).

As it relates to non-pharmacological approaches, academic sources and field practitioners have established certain recommendations and guidelines for the most effective types of interventions.

Yamaguchi et al. in the Japanese Psychogeriatric Journal emphasize the importance of **Socialization**. (Yamaguchi et al., 2010). The guidelines for non-pharmacological

interventions show how activities should bring together people and facilitate communication (therapist-patient, patient-patient). Yamaguchi et. al suggests that the environment in which such socialization occurs should encourage “error learning” in “an accepting atmosphere” that “enhance[s] their [patient] motivation” (Yamaguchi et al., 2010).

In terms of which interventions are shown to be efficacious, Cambridge University’s *Advances in Psychiatric Treatment* did a survey of existing interventions and highlighted the following as providing the most “promising preliminary results”: music therapy, life story work, multisensory approaches, light therapy, cognitive stimulation therapy, doll therapy, and exercise (Patel et al., 2014). The insights from this study helped us explore ways to categorize these therapies. As music therapy involves sound, light therapy involves vision, doll therapy involves vision and touch/interaction, and exercise involves interaction, we grouped these under **Multi-Sensory Approaches**. Additionally, life story work as defined by the Cambridge University journal involved accessing memory, or **Reminiscence**. Lastly, Cambridge along with all studies cited above mentions the importance of stimulating cognition/the brain hence we explored the theme of **Cognition**, and how our design would encourage patients to think and activate their brain functioning. Furthermore, all of the above are activities done by patients and would involve **Movement**.

In addition to the Cambridge article which was a more academic survey, we consulted a practical and working guide released to professionals working with dementia patients like work done by the INTERDEM, a pan-European network of researchers collaborating to promote psychosocial interventions that can improve the quality of life for dementia patients and their networks (INTERDEM, 2021). The topmost recommended interventions by INTERDEM had overlapped with Cambridge University’s themes and could be grouped similarly (green denotes overlap).

	Multisensory	Reminiscence	Cognition	Movement	Socialization
Art therapy					
Music therapy					
Multisensory stimulation					
Reminiscence therapy					
Cognitive Rehab					
Cognitive Stimulation therapy					
Adapted physical activity					
Dance-based interventions					

Note: We left out animal-assisted interventions and horticultural therapy just given the limitations of our Capstone. Yet, our [Observational Study](#) as part of UX Research found that even stuffed animals can improve emotional well-being as participants stroke, smile, and interact with the animal substitute for a long time period.

Lastly, as suggested by the academic recommendations (which were also supported by our [Expert Interview section](#)) we drew out these common themes to combine multiple interventions. This was supported by the National Collaborating Centre for Mental Health which states: “One intervention is often not enough because people with dementia do not only experience cognitive impairment, but often physical, emotional and social concerns as well” (National Collaborating Centre for Mental Health, 2007). Thus, there is a need to

target “multiple aspects of the person, his or her carers and environment” due to the “complexity of supporting people with dementia” (National Collaborating Centre for Mental Health, 2007).

In addition to the themes uncovered from the literature review of non-pharmacological dementia treatments, we also considered the idea of **Gamification** to help facilitate these activities. Specifically, research from non-pharmacological approaches noted the pain point in getting dementia patients to participate in the intervention. The *International Psychogeriatrics Journal* notes the “problem of participants remaining passive and refraining from active participation” and suggests gamification as a concept that can be embedded in design to make an activity “highly engaging” and “boost participant motivation” (International Psychogeriatrics, 2022).

This provided us with a new perspective to reflect back on common non-pharmacological interventions for dementia. Through this lens, we saw how all the interventions described above in the academic and practical guides for dementia treatment required heavy facilitation from a trained professional. The activities could not take place without a designated guide to lead and drive the sessions. In fact, the practical guide by INTERDEM even has a section in each intervention that gives detailed tips over several pages specifically for facilitators (INTERDEM, 2021). Additionally, Alzheimers.gov in their tips for caregivers and family members had highlighted that “people with dementia may lack interest or initiative” as it relates to social activities (National Institutes of Health, 2022). Thus, the onus is on the caregivers to start and plan the activity; yet, such an activity should be fun and not clinical in order to encourage interest in the patient to want to join. The government source provides additional suggestions on how to “motivate” the patient, else the activity, at best, will be very short and, at worst, would not be possible (National Institutes of Health, 2022). In our design, we emphasize the importance of having a facilitator since the presence of one seems crucial in all studies of non-pharmacological dementia care thus far, we explored making it easier and more interesting to engage with the interventions on behalf of the caregiver through the use of **Gamification**.

Research Question

The research questions that guided this study and project were:

1. How might a tangible user interface give new forms to the **social interaction** between the dementia patient, caregivers, and loved ones?
2. How might the interactive experience support **reminiscence**?
3. How might the interactive experience **improve users' emotional well-being**?

Concept Exploration

Gamification Concept

From the insights from the literature review, we considered the concept of gamification and what makes an enjoyable game experience first. We sought to understand the concepts we identified in-depth and tied those insights back to themes we wanted to cover when dealing with patients with dementia.

According to Hobson, game design should consider game setting, rules, components, and prompts or actions for the user (Hobson, 2022). To further explore what makes a good game we did a preliminary exploratory study at the Games of Berkeley Gameroom. The questions we sought to answer from the study and participatory research were:

- What makes some games timeless and well-recognized favorites?
- Of the games that work well, what are the elements that they share?
- If the game doesn't work or invites user curiosity and interaction, what were the weak points in the game design?
- How do different games change the social dynamic among players?

The game room allowed the project team to pick and play from 100s of timeliness classics and new games. The team tested at least 20 games and assessed them based on the above themes uncovered from our literature review of Multisensory Stimulation, Reminiscence, Cognition, Movement, and Socialization.

We noted that games that worked well shared the following characteristics:

- Games with unique pieces as shown below (Figures 1-3) encouraged more socialization and interaction with both the game and each other. We would remark on the pieces, pass them around, and ask others to interact with them so they can relate to what we're saying or feeling. The group would perform their own exploration and have conjectured about game mechanics and intent (i.e., foam shapes meant we should form them into shapes, and soft textures should be stroked). All this discussion would take place before someone read the instructions. Games with pieces also triggered players to share in-the-moment reflections and make quick remarks (i.e., "This wood is like a chess set I used to play with my dad," "These soft balls remind me of a craft we did in elementary", "I like the colors").



Figures 1-3: Game Pieces Exploration

- Instructions had intuitive illustrations demonstrating game pieces and play so that they were not a daunting wall of text. Some of these instructions could also be digested in small chunks and learned as one played the game. In Telestrations¹(shown in Figure 4), a player can go page by page for each step in the game and follow simple instructions (only a handful of words) on one page. Games with these types of straightforward rules generated interest and buy-in from the group much faster as everyone did not have to go back and forth on what the rules

¹ Telestrations® 8 Player: The Original
<https://theop.games/products/game/telestrations-8-player-the-original/>

meant and how they were interpreted by different people. This lowered the barrier for players to start the game and ensured that players did not lose interest before the game even began.

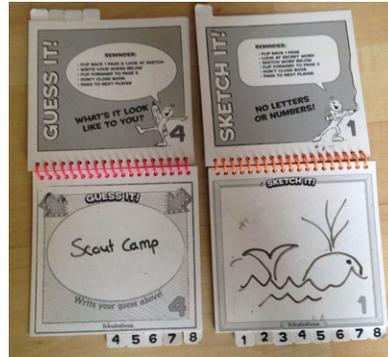


Figure 4: Telestrations' Instructions On Each Page

As we reflected back on our games discovery and exploration, we noted that the games with the focal point as objects triggered events that could be defined in the themes generated from our literature review:

- **Socialization:** The group commented on pieces and wanted to share the experience and their thoughts or feelings with each other.
- **Reminiscence:** The group remembered other items from their past that had shared similar shapes, textures, or colors.
- **Movement:** The group interacted with the items and tried to manipulate them. We also passed them around as we reached across the game table.
- **Cognition:** Because the instructions were not the center of focus or so complex that usually, only 1-2 people try to interpret the instructions and then try to teach the rest of the group, the group spent a lot of time remarking on the game pieces

themselves which led to increased communication and socialization as everyone built off each other.

Yet, the limitation here was that the objects were rather one-dimensional in that they only had one color or shape that led to a singular reaction to it. Given this, the discussion was limited as the group would only comment on one aspect of the object such that it was soft or the plastic pieces looked like stained glass.

This led the project team to wonder if there were ways to recall more complex feelings or memories from an object. This was when we began exploring the Tangible UI concept and how that can be leveraged to produce multisensory outputs.

Tangible UI Concept

To explore the tangible UI concept we started with lo-fi prototypes first. Without investing money and time to build out the technology that made an object more interactive, we wanted to test the concept to see if more complex shapes, textures, and smells would evoke more story-telling (in keeping with the Reminiscence theme from our [Literature Review](#)). The project team gathered personal items (shown in Figure 5) that stimulated more than one sense from our everyday life to share with the group and assess our reactions to them.



Figure 5: Items Used in Tangible UI Concept Exploration

The team used a role-play research method where three people explored and interacted with the objects in an unstructured way and one person observed and took notes. That notetaker noted that the red rose-shaped object was most effective at stimulating memory and conversation. The reason for this is because it very much resembled a real rose visually

and also smelled like a rose. Additionally, it could be interacted with as the petals could be rearranged and shifted around. Due to this, it reminded one person not just of roses but also of scented soap from their childhood that was delicate in the same way as the fake rose. The exploration into scent was further deepened because the person could use their fingers to move the petals aside and access areas where the rose scent was stronger.

In addition, the notetaker highlighted the effectiveness of the blue ball because its texture and feel invited people to engage in high levels of interaction with it. Because the blue ball was squeezable and the act of squeezing generated a different view of the ball (allowing users to examine the liquid and glitter inside from different angles), people would continue their interaction without even realizing it as they reflected on their remarks of it. For example, one person said this ball reminded them of finding calm during stressful times because the squeezing was so repetitive and calming, almost like breathing in and out. Yet, because the blue was visually appealing (changes to the glitter patterns inside), it also drew the person in and they reflected on how the blue reminded them of elementary school times when the teacher would decorate the homeroom in different themes - in this case, the theme was the ocean where a lot of blue and shiny fish were posted on the classroom walls.

Lastly, the notetaker commented on how after the initial person who first interacted with the object had shared, others would want to view and interact with it as well and either follow up to affirm the other person's comments or build on top of what they said. For instance, as related to the rose object as discussed, one person commented on the calming effect of the rose scent, and another affirmed and shared their story - that the rose scent reminded them of rose petal baths which seem like a nice relaxing luxury after a long day.

The insights from the role-playing activity informed the design choice of having a multi-sensory object and passing it around. This would allow everyone to participate and prolonged the storytelling.

Version 1 Game Play

Based on the research findings and concept exploration, the team did rounds of crazy 8s brainstorming sessions (Kaplan, 2017) to generate a number of different ideas (See

[Appendix A](#)). With the findings from our initial Concept Exploration, we knew that we wanted the focal point of any game we designed to be composed of portable objects that stimulated more than one sense as being able to do so triggers more reactions and potential for robust conversation. Such straightforward objects that have entertainment embedded in them would help ensure that participants were not bogged down by overly complex game rules and play conventions, and would instead allow for curiosity, exploration, and engagement.

Thus, our initial conceptualization of the end-to-end game flow is illustrated in the storyboard below (Figure 6). The object (which at the time we referred to as a “ball”) could be used during gameplay but then could also retain memories in the form of audio recordings, videos, and photos that could be accessed afterward. Having not yet formed a feasibility analysis (in terms of technology, budget, and timelines), we wanted to keep the idea as idealistic and broad as possible. The thought would be that this will allow us to diverge first and explore possibilities; afterward, we would consider what is possible and converge on a focused idea that met the target user's need, as part of the Divergent-and-Convergent Technique (Fessenden, 2019).

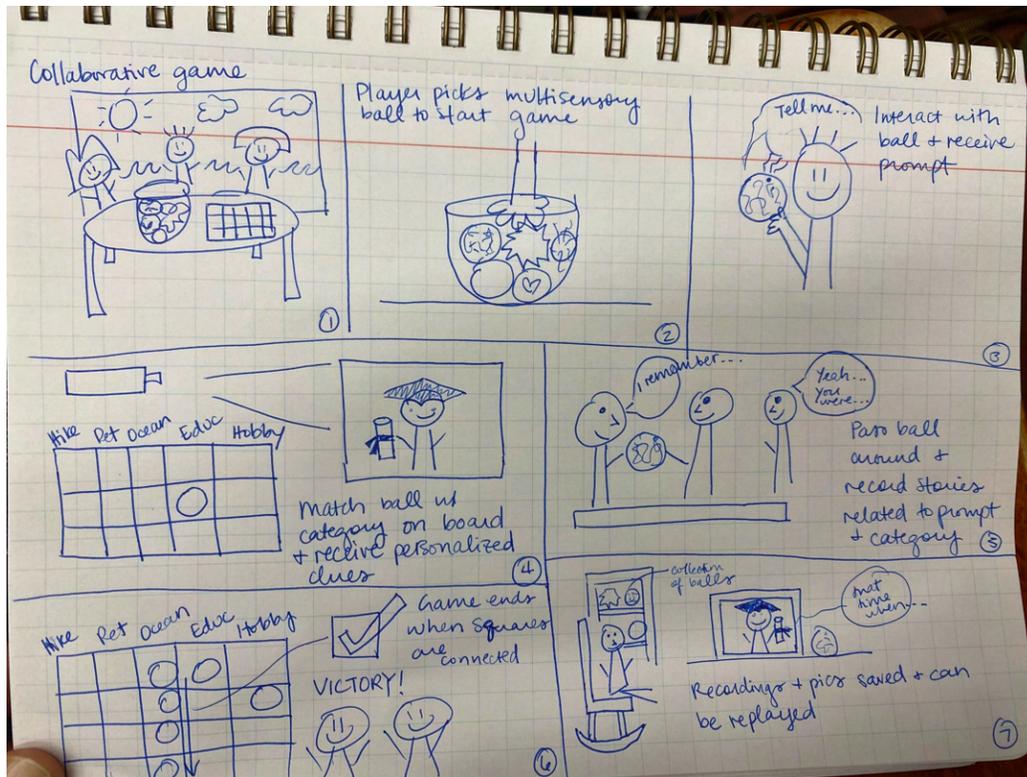


Figure 6: Version 1 Storyboard

Note: A more detailed description of the storyboard can be accessed in [Appendix B1 Game Version 1 Description](#).

Modifications to Game Conceptualization (Version 1)

We noted how the above game conceptualization had 4 different pieces in the gameplay and discussed how to narrow down our focus in terms of what should be included or not.

- Game Board: To guide players and provide structure in the course of the game
- Projector: To display community curated pictures and videos
- Ball Outputs: To stimulate the user's senses and provide a prompt to begin storytelling
- Ball Inputs: To receive and store audio recording so that the results of the gameplay can be saved for future recollection

First, as our research question was focused on how we might leverage gamification in dementia care, we knew that we needed to retain some structure and rules to our game in order to guide participants, encourage socialization, and perhaps even provide a sense of accomplishment in working together as a team during the game duration. Also, our preliminary review at the Games of Berkeley showed firsthand that if we did not have any overall guidelines then the game pieces would be disparate and disjointed and take on too many different interpretations based on what the players felt like doing. As an example, at Games of Berkeley, when the group played the blocks game, the defined rules helped us work together with those constraints in order to create a desired shape. This forced us to interact more than we otherwise would have because otherwise each person would just pick the blocks individually and create the shape according to a vision of the shape they want in their own minds. Thus, we decided that the board must be retained as it gives sense to the tangible objects and ties all pieces together. At the conclusion of storytelling activities, the game also encourages collaboration by bringing everyone together as they discuss their stories and the category they fit into.

Design Guidance: The Game should have some structure rather than be entirely unstructured. Thus, we chose to retain the idea of some form of a game board. In Usability Study (mid-fi prototype), we compared scenarios with and without the game board to further test and validate this design guidance.

In regards to the projector, when we took a step back to analyze its purpose, we decided that this can be considered a case of over-engineering. While it did allow for personalization in the game as players could submit personally curated videos and photos, it was rather unnecessary because game players could just bring physical copies of photos or show videos from their phones or computers. The projector provided a different way to display the data but the end result was the same. Consequently, we decided to remove the projector and rely on the multisensory outputs embedded in the object to be widely relatable and trigger different memories or responses from different people.

Finally, we needed to make a decision on the object design and, as per our research sub-question, how the object can be leveraged to invite new forms of socialization and

reminiscence for the patient and their surrounding network playing the game. To do this, we tested lo-fi prototypes of differently colored and shaped objects (shown in Figure 7) in a Wizard of Oz setting. Our primary goal was to analyze how the objects as shown below (while they lacked multi-sensory outputs) would be handled as the group shared stories and passed them around.



Figure 7: Wizard-of-Oz Paper Prototypes

Again, out of the group of 4, 1 person was designated as the observer and notetaker. This person noted that when one person had the item, they would make eye contact with others as they shared their remarks. Other people without the item would make affirming comments or other remarks after the person with the item had finished sharing. For instance, “Wow I never knew that your dad had traveled so much!” Additionally, players would hold the object at varying levels in a comfortable manner, with some even fidgeting with or stroking it unconsciously as they talked.

Design Guidance: The purpose of the game object is to facilitate robust discussion and socialization that occurs organically as the player interacts with the object. Thus, we dropped the audio recording component and focused our attention on effective multi-sensory outputs.

Given those design decisions, the modified game flow concept is shown in Figure 8.

Version 2 Game Play



Figure 8: Version 2 Storyboard

Note: A more detailed description of the storyboard can be accessed in [Appendix B2 Game Version 2 Description](#).

User Research

To validate our design choices and version 2 of the game, we did some rounds of user research. This allowed us to make iterative design decisions and further tweak the game as shown in Version 2 to ensure it meets the needs of our target user. Below are the various research activities we conducted and their intent:

- **Expert Interview:** Validated game concept (Version 2) with an expert in the academic area of dementia. This allowed us to validate finer details of the project design and proposed implementation.
- **Caregiver Interview:** Conducted interviews to understand the day-to-day activities and feelings surrounding care and relationship with a person that has dementia. This allowed us to develop empathy and understanding for dementia patients and let that guide our design.

- **Observational Study:** Observed common psychosocial activities at a senior center similar to those that patients with dementia would engage in. This allowed us to understand social activities that work well and their limitations that can be incorporated into our design.
- **Usability Study:** We did a usability study on both lo-fi and later high-fi prototypes. The goal was to first identify usability issues specifically focusing on how easy it is for new users to accomplish tasks and later to get feedback on ways to improve the game designs.

Expert Interview

We interviewed a domain expert in the dementia field. A professor in the Psychology Department at UC Berkeley, whose research work extensively revolves around and ties closely to dementia patients and their caregivers. Our questions for him centered around understanding the following:

- The interactions between patients and caregivers (i.e., how the relationship affects well-being, barriers to developing a trusting bond, existing common activities, reminiscence)
- How stigma may or may not affect patients and their caregivers' relationships
- Lastly, we also walked through Version 2 of our game with him. We wanted his thoughts on the concept to ensure that we were headed in the right direction for our product.

(see [Appendix D1. Expert Interview Guide](#) for details):

Our main takeaways were as follows:

- Patients with early-stage Alzheimer's disease may have problems with forming new memory, but generally would still retain the ability to recall memories from the past, and thus may enjoy the act of reminiscing.
 - **Implication to Project:** We further narrowed down our target user by specifying that this product is designed for early-stage Alzheimer's patients and their support network.

- People with early-stage dementia are well aware of their loss of function. Our current prompts which ask game players “do they remember” or “what does this remind you of” seem as if we are testing the patient and grading them on their ability to answer the question. In this way, if the patient does not have the “correct” response, they may feel as if other players are exposing gaps in their memory.
 - **Implication to Project:** This led to another **Design Guidance: Game prompts should be worded with intention so that prompts are not interpreted as having a right or wrong answer and testing the patient on their capabilities.**
- He stressed that dementia affects each individual in a very different way and all have a highly dissimilar experience with the disease. For instance, some may have motor issues while others have comprehension issues. Thus, it is helpful to take advantage of as many senses as possible, as it would increase the number of ways to trigger memories.
 - **Implication to Project:** This led to another **Design Guidance: Game objects should seek to engage with as many senses as possible.**
- He also mentioned that from a social support perspective, the caregiver can become disenchanted with the relationship (i.e., child taking care of a parent with dementia, spouse taking care of partner with dementia). As in line with our findings from the literature reviews, the relationship between patients with dementia and their family members can be strained by dementia.
 - **Implication to Project:** Given the stresses and strain of everyday caregiving, this is the derived **Design Guidance: Gameplay should be an enjoyable and fun experience for patients and their support network in order to strengthen relationships.**

Caregiver Interview

We interviewed 5 caregivers and family members of dementia patients. These were conducted over 30-minute Zoom or phone interviews where our goals were to:

- Understand their relationship with the dementia patient

- Understand the existing activities they currently do with the patient
- Understand what they think is lacking from care

(See [Appendix D2. Caregiver Interview Guide](#) for details.)

The key takeaways from the interviews include the following:

- Through the interviews, we discovered two distinct groups of dementia patients: **Resistant to OR Accepting of** their dementia diagnoses. Those who were resistant had a hard time with the disease and its progression faced internal stigma around their diagnoses and did not have an interest in games and activities due to the limited trust of family and caregivers. Those who were accepting placed more trust in family members and as such enjoyed participating in games and activities.
 - **Implication to Project:** This knowledge would affect our market sizing in the future after we launch our product. While there is a user group that wants brain-stimulating activity and bonding, another sizable group is opposed to the idea.
- Of the dementia patients who enjoyed activities, caregivers noted positive effects of the activity/intervention on the patient. About his dad with dementia, an interviewee recounted “tears of joy were running out of his eyes after participating in an interactive activity with music therapy” and commented how this strengthened their bond as the dad was then more willing to express emotion.
 - **Implication to Project:** This helped answer part of our research question on how an activity could help improve the emotional well-being of patients.
- Multiple caregivers spoke of the mundane, straining logistics of caregiving like grocery shopping, house maintenance, appointments and medication management, among others. They express a desire for shared activities to take the burden off the present and strengthen social bonds in a neutral setting where caregiver and patient can be closer to equals rather than in a relationship with a power imbalance in which one is managing the other.

- **Implication to Project:** This led to another **Design Guidance: All game players (with exception of the facilitator) should be treated as equals and share the same type of role.**
- In terms of what could be improved in their interactions with the patient, caregivers outlined the need for more stimulation. Examples from interviews showed that each sense tended to be stimulated individually like *only* listening to the guitar or *only* viewing old photographs.
 - **Implication to Project:** As we were combining senses via our multi-sensory objects, it would be interesting to test if it is more effective to have more stimulation as also requested by caregivers in the user interviews.

Observational Study

We did an observational study and unstructured interviews at a seniors' daycare center that had professional caregivers and psychologists who ran psychosocial activities in a group setting. The goals for the study were to:

- Understand the current activities patients & caregivers engage in
- Observe the pain points with current activities
- Identify the needs and insights

Our key takeaways were the following:

- All the activities held in the center required a facilitator to guide the group and create a safe environment for gameplay and interaction. Without a facilitator, participants would engage in individual activities and not socialize with others.
 - **Implication to Project:** This led to another **Design Guidance: The game should accommodate a facilitator role; yet, the person in this role must treat all other players as equals.**
- All activities observed in the center had straightforward and easy rules. The facilitator especially faces the challenge of motivating a large group of people to participate in an activity together at the same time. It was observed that sometimes

it was difficult for all participants to hear the instructions across the table and not everyone was invested to learn and remember game rules.

- **Implication to Project:** This led to another **Design Guidance: The game should have low barriers to entry and gameplay.** (i.e., avoid overly complex rules, have intuitive next steps in the game, and instructions can be quickly explained.)

Usability Study (mid-fi prototype)

We performed a usability study with new users to our game using mid-fi prototypes. The table below includes the 4 tasks that were tested to assess success or failure, and the main findings in each task that yielded implications and considerations for our project (see [Appendix D3](#) for study guide). In addition to considering our [Design Guidances \(Appendix C\)](#) gathered from other research, we would also need to think about how to incorporate these findings as we finalize our design.

Task	Findings	Implications to Project
Task 1: Setup and prepare the game	<ol style="list-style-type: none"> 1. A facilitator is recommended 2. Make the instructions more appealing (i.e., more intuitive visuals vs text) 	These matched our Design Guidance to include a facilitator and reduce barriers to entry/starting the game.
Task 2: Pick an object, interact with it then share a story of what it reminds you of	<ol style="list-style-type: none"> 1. Having extra senses stimulated allowed for more discussion 2. A mismatch between the different outputs/senses triggered by the object can lead to confusion (i.e., ball plays birthday music but is contained in hamster ball) 	<p>Finding 1 matched our Design Guidance to stimulate as many senses as possible.</p> <p>Finding 2 suggests a new Design Guidance: Ensure that the senses stimulated by the game object are in</p>

		<p>harmony with each other.</p> <p>(i.e., if nature, sound, look, smell, and feel all reflect the same theme)</p>
<p>Task 3: Pass around the object and build on others' stories or share your own story or feelings</p>	<ol style="list-style-type: none"> 1. "When everyone is sharing, you feel like what you say should be different from what others have said" 2. Stressful when all people are focused on the person with the object 	<p>These matched our Design Guidance to make the game experience fun and enjoyable. We should consider how to set up the rules such that a comforting, relaxing environment is fostered.</p>
<p>Task 4: End to end gameplay with the instructions + objects + game board</p>	<ol style="list-style-type: none"> 1. Participants played the game with just the objects vs objects + game board. They noted that having the board makes the game more exciting and invites more socialization. 	<p>This matched our Design Guidance to include a game board.</p>

Consolidated Design Guidance

As we finalized our design, we referenced the [Design Guidances \(Appendix C\)](#) collected during the course of our concept exploration and user research phases. These allowed us to incrementally modify our product design so that we can more closely match it to the needs of our target user.

Final Design



Figure 9: Overview of Final Design

Game Setting

At first, we were creating this game to be played at home, with one person with dementia and their family members, and the stories they share would always be something related to the patient. However, after the user research, we found that this game could also be played at care facilities with more than one patient because users felt a connection after playing the game even if the stories they shared were not necessarily related to each other.

With the facilitator role included, we also decided to take out the self-affirmation category from [Version 2](#) of the design to further simplify the game board. We instead incorporated the self-affirmation aspect as an overall prompt as it became the main focus to enhance the

emotional well-being of patients. This included prompts to share what they were grateful for and how they felt when interacting with the TangiBalls.

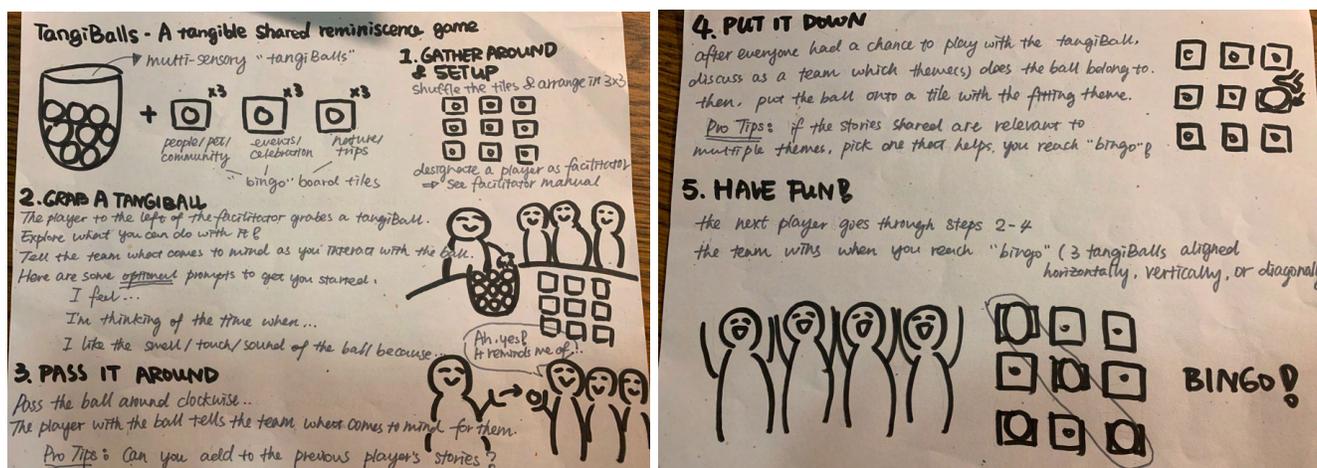
End-to-End Game Play

Below is the end-end gameplay instructions:

Interact with the TangiBall and share what comes to mind.
Put the TangiBall on a board tile representing the stories shared.
Players win when 3 TangiBalls are aligned!

 Step 1: Set Up Shuffle the 9 board tiles, and arrange them 3x3.	 Step 2: Pick A TangiBall Ask the player on your left to pick a TangiBall.	 Step 3: Show & Tell Ask the player to share what comes to mind as they interact with the TangiBall.
 Step 4: Pass It Around Pass the TangiBall around. Each player shares what comes to mind for them.	 Step 5: Put It Down Ask the team to collectively decide which tile to put the TangiBall on. (The theme of the tile should fit the theme of the stories shared.)	 Step 6: Have Fun! Each player take turn to repeat steps 2-5. The team win when 3 TangiBalls are aligned vertically, horizontally, or diagonally!

Figure 10: Game Instruction Concepts of Final Design



Figures 11-12: Game Instruction Paper Distributed to Players

Through the end-to-end gameplay and feedback from the usability study, we recognized that facilitator is a key role in this game since players' ability to interact with objects and come up with stories would significantly be different from each player. A facilitator's role would be to ensure that participants, especially the patients are able to engage with the objects and share feelings or stories that the object invokes.

Additionally, based on the feedback from the usability study, we designed the instruction manual with more images rather than just text because according to the study insights, instructions that were too long and text-heavy overwhelm and may distract players.

Game Board

The game board consists of 9 board tiles. The board tiles represent three themes namely community/people, nature, and events/celebration (as shown in figure 13).

The community-themed board tiles have images of people holding hands and of a hand-to-paw high-five. This theme represents stories shared about people, pets, and communities. The nature-themed board tiles have images of mountains, lakes, and trees. This theme represents stories shared about nature or outings. The celebration-themed

board tiles have images of gifts and confetti. This theme represents stories shared about celebrations, holidays, or other joyful events.

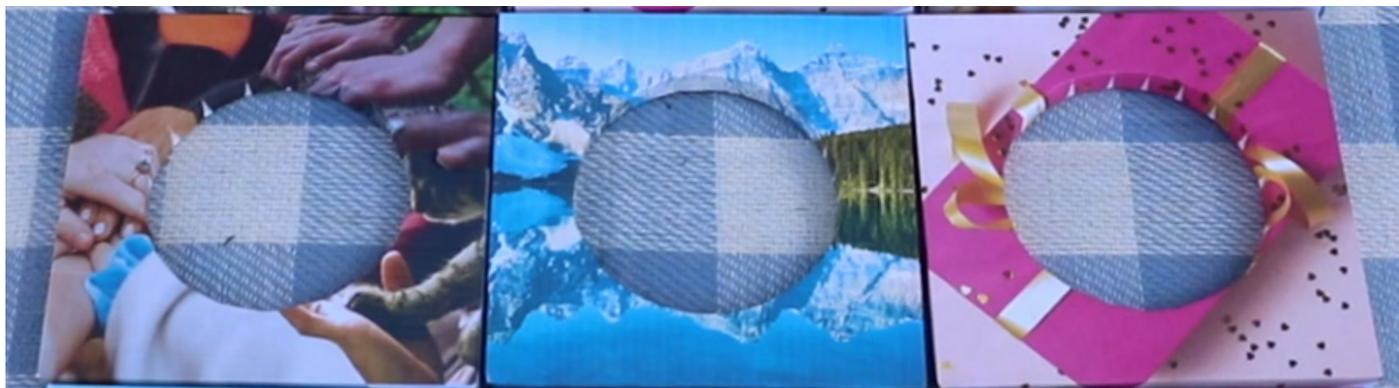


Figure 13: Board Tiles Representing 3 Themes. From Left to Right: Community, Nature, and Celebration²

Having considered different feedback on the game board, we decided to have a game board to have more structure, a clear goal (feeling of achievement and knowing what to do with the game), and general themes to get the players started with sharing their stories. We used visual clues (images) to make the theme of the board tiles straightforward. Also, since the board should be capable of holding objects of different shapes and sizes, we made a hole in each board tile to improve affordability – so that players could easily figure out where to place the TangiBalls after collectively deciding where they belong.

Game Objects (TangiBalls)

For the tangible objects, we decided to implement some key elements that we had found out were necessary for the gameplay. This includes having multiple features to stimulate different sensory and covering different categories and making different features of the object such as appearance, smell, and texture to be consistent to avoid confusion, but should also be open to interpretation to encourage interaction.

² Credits: Photo on the left of ‘Community’ board tile is by [Hannah Busing](#) on [Unsplash](#)
 Photo on the top right corner of ‘Community’ board tile is by [Shane Rounce](#) on [Unsplash](#)
 Photo on the bottom right corner of ‘Community’ board tile is by [Jonas Vincent](#) on [Unsplash](#)
 Photo on the ‘Nature’ board tile is by [John Lee](#) on [Unsplash](#)
 Photo on the ‘Celebration’ board tile is by [Ekaterina Shevchenko](#) on [Unsplash](#)

Implementation

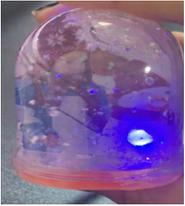
Grounded on the research findings we decided to include diverse multi-sensory stimulating objects some high-tech, mid-tech and low-tech. We wanted to explore whether any one of these had more impact on reminiscing.

For the high-tech objects, we used Arduino to build tangible UI objects that had sensor inputs i.e an acceleration sensor(a motion sensor) and a capacitive sensor(which uses a conductor to detect touch). These sensors required some interactions to be triggered eg shaking or squeezing. When triggered they produced some specific outputs including lighting led bulbs or producing sound using the piezo speakers. The LEDs were used to stimulate light as well as colors for instance in one of the TangiBall we used three LEDs with fading lights that produced some ambient colors when combined. For further information on the code implementation check out the [Github](#) page.

For mid-tech TangiBalls, we utilized a small recorder to record different sounds eg nature, animal sounds, and people (Martin Luther King). We then explored different textures. These Tangiballs would be triggered to play the sound when squeezed, further inviting exploration from the participants and a sometimes element of surprise.

Finally, the non-technical Tangiballs contained no tech implementation, instead, we explored different textures, weights, colors, and smells. These Tangiballs would allow exploration and open to interpretation for participants. Testing it during the usability study we found out that these would trigger unexpected memories from different users making the game more fun and unpredictable every time it is played. For future implementation, these would be used for personalization as people can provide their own Tangiball or memento especially those that the patient are more familiar with.

Considering these elements, the following table is a list of representative TangiBalls³.

Intended Story Theme	Figures 14-16: TangiBalls	Sensory Stimulations	Interactions	Implementation
Community		<p>Visual: news headlines and picture of Martin Luther King Jr.</p> <p>Auditory: 'I Have A Dream' speech</p> <p>Tactile: Paper collage</p>	<p>Squeezing or pressing this TangiBall will trigger a recording of the speech to play.</p>	<p>We secured a mini recorder inside of this TangiBall (with the same technology used at a Build-A-Bear workshop.) The surface of the ball is a collage of printings from old newspaper articles featuring the speech.</p>
Nature		<p>Visual: tree nuts and brown/green color scheme representing nature</p> <p>Tactile: tree nuts and pipe cleaners</p> <p>Olfactory: mixed forest fragrance</p>	<p>No technology-enabled interactions. Players can touch and smell</p>	<p>We glued forest-fragranced-infused tree nuts together to form a spherical structure, and bound the TangiBall with pipe cleaners to add more texture and color.</p>
Celebration		<p>Visual: snow globe, a picture inside, and light</p> <p>Tactile: smooth plastic</p> <p>Proprioceptive: the body movement of shaking and holding still</p>	<p>Shaking the snow globe will trigger the light to gradually light up, accompanied by the 'snow' falls. When shaking stops, the light gradually dims down.</p>	<p>We used an acceleration sensor to detect the shaking movement, and used Arduino to read the acceleration input and control the LED light. The picture inside the snow globe can be personalized.</p>

Usability Testing (Final Design)

We performed a usability study with professional caregivers at the seniors' daycare center. We played the game in a group of 5 people. 2 staff members and 2 of our team were players and 1 of our team members played a facilitator role. We did end-to-end play of the game to

³ See [appendix E](#) for a collage of all the TangiBalls.

uncover any usability issues with the game flow as well as gain insights from actual caregivers who interact with patients on a daily basis.



Figure 17: Usability Study at the Senior Day Care Center

After playing the game, we asked for feedback from the participants. Overall, participants were satisfied with the experience. They enjoyed the interaction with the multi-sensory objects with different features and came up with different ways to play the game.

One thing they emphasized was the importance of a facilitator. They suggested that preparing a variety of different questions at the facilitator's hand would help players get the most out of the game.

In terms of prompting the players to share what comes to mind as they interact with the TangiBalls, the participants suggested asking the players to describe the object first, so they can take the time they need to experience the interaction and reflect on the stories. This was interesting because in the usability study (mid-fi prototype) when users were asked to describe the objects, they focused too much on describing features and shared less about their stories. With this in mind, in the facilitator manual, we are suggesting that the facilitators ask follow-up questions to guide the user in sharing their stories. One concern we have had was whether or not this game looks childish and might offend some seniors.

The participants, who were familiar with activities and games at the senior care facilities, explained that this game appears reasonably sophisticated because of the richness in context (the ‘I Have A Dream’ speech, for example,) and variety. They were very interested in potentially playing this game with members at their facility in the future. This usability study further validated that our game is feasible not only in the home setting but also can be adapted to cater to the needs of the patients and staff caregivers at senior care facilities.

Given the feedback, we created an additional guide for the facilitator (see [Appendix F MVP Facilitator Manual](#)) and kept the instruction paper as digestible as possible. We removed some instructions from the paper and incorporated them into the facilitator manual.

Future Directions

Facilitator Manual

As discussed in the usability study of our high-fi prototypes, we found the role of the facilitator crucial for the game. To alleviate the burden of caregivers who might take on the role of the facilitator, and to help players get the most out of the game experience, we believe that future efforts could focus on the facilitator manual. Specifically, suggestions and optional scripts could be provided to the facilitator to help them set the stage for the game, prompt and guide the players throughout each turn, and recap and wind down the game in the end. We have included an MVP version of the Facilitator Manual in [Appendix F](#) for reference. We also want to point out that as highlighted in the Facilitator Manual, the facilitator should make sure to create a safe space for the players of the game – with patience, respect, and making sure that they feel comfortable and welcome. We also included “Pro Tips” for how to encourage the players to share their stories and guide them towards certain themes if necessary. With more people playing the game, we could see a future version of the Facilitator Manual become a living document, or even an online forum, where people can share their experiences and tips.

At the end of the MVP Facilitator Manual, we also discussed other ways to play the game. If players are tired of lining the TangiBalls up, they could make up their own rules. Fill up all the tiles, have on TangiBall in each theme, or focus on one specific theme, to give some

examples. With the foundational elements of multisensory stimulation and shared reminiscence, we believe that TangiBalls can be adapted to fit different players' needs and interests. For example, one could switch up the theme tiles, add rules to the game, or personalize and create their own TangiBalls. For future work, it would be interesting to create optional expansion packs covering a larger variety of themes and TangiBalls.

Game Components

Along the lines of multi-sensory stimulation therapy, we aim to incorporate a variety of stimuli that would enrich the experience of players. Some other variables we might want to test out in future iterations of this project would include the temperature and the weight of the TangiBalls. We would also want to explore more ways of incorporating olfactory senses that better targets the players' memory – how might we synthesize a smell from one's memory?

Another area of consideration would be the sustainability and longevity of the product. What happens when we take the depreciation of the tangible interface into consideration? What happens when the battery dies, or when the switches break? Future work on the game components could be to design for the durability of the product.

Game Play and Other Applications

We learned from the usability study that some care centers have limited resources and would prefer products that are adaptable to different scenarios. As discussed in the facilitator manual section, we want to open up the possibilities for the players to design their own game rules. One example is to incorporate more movements in the game (such as throwing and catching the balls). These adaptations of the game would be highly dependent on the motor and the cognitive capabilities of the players. Additionally, with new adaptations of the game, unexpected pain points could arise. One example of this we want to reflect on is when negative memories or emotions are triggered during the game. As a future direction, we would want to provide support and guidance in the facilitator manual regarding how to address negative turns of events during the game.

Another application of this game involves educational purposes. This game could be used for education through both prompts and objects' perspectives. For example, using objects with specific purposes such as nutrition education, and encouraging users to think about specific topics could be one way of implementation. Similarly, we are also considering the potential of using this game as a tool to raise awareness of the dementia community. Future studies could examine if such a game, when played by the general public, could change their understanding about, or potentially reduce their stigma towards, people living with dementia.

Limitations

As we stated at the beginning of the paper, our product is intended to work for early-stage dementia patients, more specifically, early-stage Alzheimer's patients. Stimulating their sensory and triggering memory would be difficult for people with more severe cognitive impairments. While patients at different stages of their diseases would have different needs, we also want to reflect on the possibility of improving the accessibility of the game to a broader audience.

Due to the scope of this project, we did not have the opportunity to learn first-hand information directly from dementia patients. Although domain experts, family members of people living with dementia, and professional caregivers gave us substantial valuable feedback throughout our research, design, and testing process to improve our product, we could benefit from the inclusion of dementia patients in these stages of the project to co-design the product that better cater to their needs. Given the time and resources, our next step would be to test the game with people living with dementia and incorporate their feedback into the next iteration of the design. To more rigorously test the effectiveness of the design, we would also want to design a more robust and longitudinal study that compares the treatment group against the control group regarding aspects of changes in emotional well-being and quality of life.

Conclusion

In conclusion, we found that our tangible user interface could give new forms to the social interaction between the dementia patient, caregivers, and loved ones by combining the essence of existing interventions (such as multi-sensory stimulation and reminiscence therapy) with the joyful, stress-free, yet structured setting of a game. The multisensory stimulations of the game objects (TangiBalls) help trigger positive emotions and prompt the players to share fond memories from their past; The digestible and accessible design of the game help facilitate the shared reminiscence experience and strengthen the emotional bond among the players; While the detailed facilitator manual and the adaptability of the game alleviate the stress for caregivers and open the door to limitless applications of the game.

The final design of the game followed the design guidance ([Appendix C](#)) we distilled from literature review and UX research, which we believe could be beneficial to future designs for the dementia community. We aimed for the final design to represent a variety of senses and interactions and to emphasize the socialization aspect of the gameplay. With the structure of the 'Community', 'Nature', and 'Celebration' story themes, we aim to inspire the players to reflect on and share their positive emotions and memories with each other, thus strengthening the connection among the players. As discussed in the future directions and the limitations sections above, there are still aspects we have yet to explore. We would like to co-design with people living with dementia to improve our future iterations of the game, and to expand the game to cater to the different needs of people in different settings (home v.s. care facility) and stages of their dementia journey.

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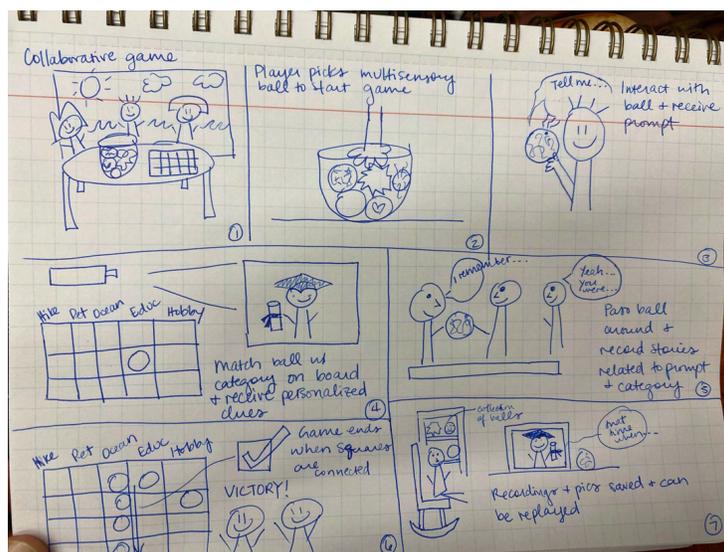
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Appendices

Appendix A. Crazy Eight Workshop



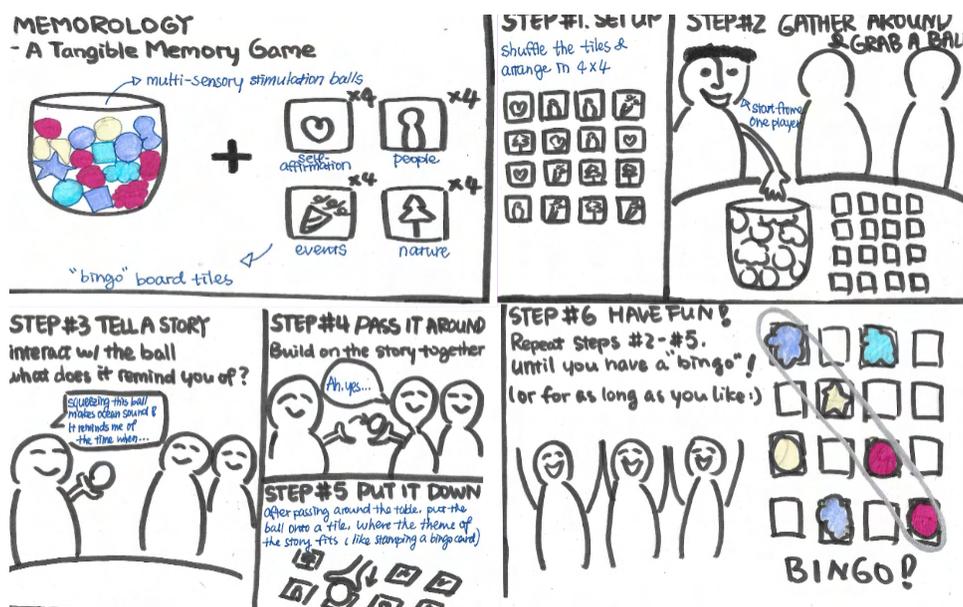
Appendix B1. Game Version 1 Description



1. Game players sit around a table that has game pieces (objects + board).
2. To start the game, a player will reach into a container with all the objects mixed in and pick an object.
3. The player must interact with the object to trigger a prompt or other multisensory output. The player can either share the memory directly here or proceed to the next step for personalized clues as desired.
4. If the player wants to access additional multisensory outputs in the form of photos and video recording, they would match the object to the closest related category. Upon placing the object on the board, a projector will play videos and photos with sound. Note: These multimedia forms would need to be collected from the community surrounding the dementia patient prior to the start of the game.
5. The player can record their memory or thoughts/reactions as they share verbally related to the object prompt or projector clues.
6. After sharing, the player will place the object back into the category. The rule of the game is to connect the squares on the board in either a line or diagonal in order to achieve the Win state.
7. Because audio recordings, videos, and photos are associated with the object, after the game concludes, the patient can take the object away as a memento. Paired with a device that could replay the data stored on the object, the patient could access memories related to the gameplay in the privacy and comfort of their own home.

Appendix B2. Game Version 2 Description

The descriptions as listed below match with the numbered panels of the storyboard in the figure included in [Version 2 Game Play section](#):



- Player starts by assembling the game board. The object and memories or thoughts evoked will fall into 4 categories of Self-Affirmation, People, Events, or Nature.
- Player selects a multi-sensory object from a container.
- Player interacts with the object and thinks about what it reminds them of.
- All players will interact with the object and share their thoughts or memories.
- Following story-telling, players will work collaboratively to determine which category best fits their discussion and place the object in that category.
- The Win state is achieved when objects have connected the squares on the board in either a line or diagonal. The game ends.

Appendix C. Design Guidance

- The game should have some structure rather than be entirely unstructured.
- The purpose of the game object is to facilitate robust discussion and socialization that occurs organically as the player interacts with the object.
- Game prompts should be worded with intention so that prompts are not interpreted as having a right or wrong answer and testing the patient on their capabilities.
- Game objects should seek to engage with as many senses as possible.
 - Ensure that the senses stimulated by the game object are in harmony with each other.
- Gameplay should be an enjoyable and fun experience for patients and their support network in order to strengthen relationships.
- All game players (with exception of the facilitator) should be treated as equals and share the same type of role.
 - The game should accommodate a facilitator role; yet, the person in this role must treat all other players as equals.
- The game should have low barriers to entry and gameplay.

Appendix D1. Expert Interview Guide

Questions

THEME 1: emotion and interaction between PWD and the caregivers

In your talk in 2018 at the Alzheimer's Association's Conference, you discussed the idea of the people with dementia and their caregivers being on 'a shared journey.' And in your lab's researches, we see an emphasis on the emotional well-being not just of the patients but more interestingly of the caregivers.

- How does the patient-caregiver interaction play a role in their emotional wellbeing or vice versa?
 - Major barriers to patient-caregiver interactions?
 - Activities/tools/strategies/guidelines to facilitate this interaction?
- How do you measure the interactions & emotions/ wellbeing

THEME 2: emotion and stigma

- How does stigma play a role in the interaction and emotional well-being of the people with dementia and their caregivers?
 - Specific concerns
 - Activities/tools/strategies/guidelines to help reduce stigma?

THEME 3: emotion and reminiscence

We want to facilitate fun and joyful patient-caregiver interactions with a board game that incorporates multi-sensory stimulation therapy reminiscence.

- What are the top activities that caregivers and family members do with patients of dementia?
- Expert Review: Here is our current design. Are there any Problems, strengths, or recommendations, you'd like to share with us based on what we discussed?

Wrap-up

You've been so helpful; I really appreciate the time you've taken to talk with me. Thank you very much. Before we finish, is there any last thing you would like to share with me?

Appendix D2. Caregiver Interview Guide

Questions

1. What is your relationship like with your family member/patient?
 - Are you the daily caregiver or a long-distance caregiver?
 - Who is taking care of her daily?
 - How often do you visit him/her? Or call him/her?

2. Can you describe approximately how severe the patient's memory disease is?
 - How long has he been suffering from it?
3. Can you give a brief description of your family member's/patient's experience living with a degenerative memory disease?
4. What sorts of activities do you currently do with your family member/patient?
 - Do you do any memory-specific activities?
 - Are these interactive activities that you are involved with?
 - Are these physical activities or virtual?
 - Can you walk us through the experience of the activities?
 - How do the patients feel after these activities?
5. What sorts of activities are your favorite? What sorts of activities do you think are your family member's/patient's favorite?
6. How often do you do these activities?
7. Have you/the patients experienced any frustrations during the activities?
 - Can you describe that for us?
 - What's your feeling about it?
8. What are the barriers to doing these activities? (If they mention they seldom do these activities or give up after a try)
9. What do you think is missing?

Wrap-up

You've been so helpful; I really appreciate the time you've taken to talk with me. Thank you very much. Before we finish, is there any last thing you would like to share with me?

Appendix D3. Usability Study Guide

Usability Study (mid-fi Prototypes)

Before We Begin

1. We will evaluate from the perspective of family caregivers & Alzheimer's patients
2. Scenarios and tasks we will analyze
 - a. Gameplay with only the multisensory balls + instructions

- i. Task 1: pick a ball and interact with it
 - ii. Task 2: share a story
 - iii. Task 3: pass the ball around
 - iv. Task 4: the next player picks a ball
- b. Gameplay with the multisensory balls + instructions + prompts
 - i. Task 1: pick a ball and interact with it
 - ii. Task 2: share a story (could be an answer to the prompt)
 - iii. Task 3: pass the ball around
 - iv. Task 4: the next player picks a ball
- c. Gameplay with the multisensory balls + instructions + board
 - i. Task 1: set up the boards
 - ii. Task 2: pick a ball and interact with it
 - iii. Task 3: share a story
 - iv. Task 4: pass the ball around
 - v. Task 5: put the ball on the board
 - vi. Task 6: the next player picks a ball
 - vii. (if we have enough time) Task 7: keep playing until we have a bingo

Ground Rules

To ensure that the meeting is efficient and stays focused on the tasks, communicate basic ground rules for evaluators.

- The conversation should remain focused on user reactions to the existing experience. The walkthrough session is not the time for brainstorming or recommending design changes.
- Participants should not justify or discuss the reasoning behind the current design of the interface.

Determine Success or Failure for Each Action

The evaluators' goal is to determine whether the user is likely to succeed at each step in the predefined action sequence; they should also document why that determination was made.

In order to determine whether the user is likely to succeed, evaluators should discuss 4 key questions (analysis criteria) at each step:

- Will users try to achieve the right result?
- Will users notice that the correct action is available?
- Will users associate the correct action with the result they're trying to achieve?
- After the action is performed, will users see that progress is made toward the goal?

To streamline the recording process during the walkthrough, we use a template for recording the group's decisions manually.

Task		Action success		Action failure	
Action step					
Will the user try to achieve the right result?	yes <input type="checkbox"/>	from experience	the system tells them to	no <input type="checkbox"/>	
Will the user notice that the correct action is available?	yes <input type="checkbox"/>	from experience	they would see a call-to-action	no <input type="checkbox"/>	
Will the user associate the correct action with the effect they're trying to achieve?	yes <input type="checkbox"/>	from experience	a prompt/label matches action	no <input type="checkbox"/>	
After the action is performed, will the user see that progress is being made toward the goal?	yes <input type="checkbox"/>	from experience	there's a connection between the system response and user goal	no <input type="checkbox"/>	

The recorder fills in the overarching task and the specific step. For each of the four analysis questions, the recorder marks the appropriate answer — yes or no. For each question, the group should be able to explain why this is the correct answer.

If the answer is yes, there are some common reasons for success for each question. To streamline the recording process, we've included these common reasons in the Yes column of the template (from experience, the system tells them so, etc.). If one of these reasons applies, the recorder can simply circle the appropriate reason. If the reason is not given, the recorder should write the reason for the Yes determination in the cell below.

If the answer is no, the recorder should also write why exactly this determination was made by the group.

Reference

[How to Conduct a Cognitive Walkthrough Workshop](#)

Appendix E. Other TangiBalls



TangiBall made out of grass texture and produces sound of nature when squeezed



Arduino implemented TangiBall with fading lights visual stimulation which plays birthday song when touched



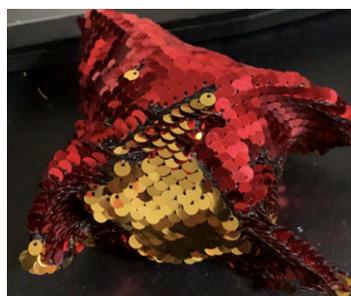
Fur textured stuffed cat that produces cat sound when squeezed



Non-tech multicolored soft TangiBall that allows user interpretation and imagination

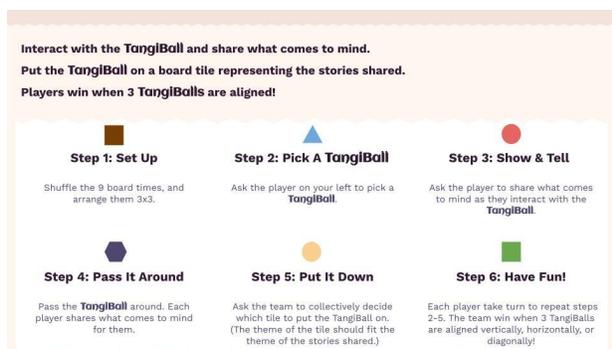
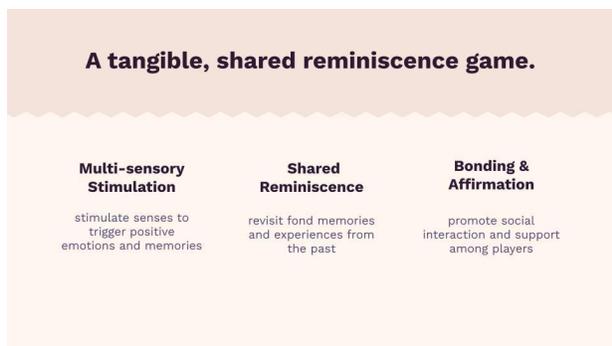


Non-tech tangible soft TangiBall with lavender scent for smell stimulation and open to interpretation



TangiBall with playful texture, has some weight and contains a bell inside that rings when shaken. Open to interpretation

Appendix F. MVP Facilitator Manual



At the Beginning

Welcome the Players/Set the Stage/Ground Rules

We recommend going over the game rules at the beginning, so players feel comfortable with what to expect. Also go over some game values/ expectations relevant to your community – inclusivity, creating a safe space, patience, respect, to name a few.

Check if the players have any questions or concerns before starting the game. We recommend that you demonstrate the game as you explain the rules, to provide an example for how a turn of the game works.

Pro Tips: to avoid overstimulation, we recommend keeping the **TangiBalls** in the bin at the beginning of the game, rather than laying them all out on the table.

Pro Tips: to get players interested in interacting with the **TangiBalls**, consider briefly showing each TangiBall to the team before putting them in the bin.

When Players Interact with TangiBalls

Prompts/ Follow Up Questions

We recommend first asking the player to describe the **TangiBall** they have – to get the conversation started.

- What does it look/feel/smell/sound like?
- Is it heavy/light?
- What happens when you squeeze/shake/press it?

If the player is struggling to come up with a specific story, we recommend asking about the emotions triggered.

- How does it make you feel?
- Is it exciting/calming/thought provoking? What makes it so?

Ask follow up questions about the key elements the player mentioned. Keep in mind that you can focus on positive emotions and affirmations among the other players.

- You mentioned _____, what do you love about it?
- Does anyone else remember when _____?
- Does anyone else think/feel _____ ?

Pro Tips: encourage the players to share, but also make it clear that they could skip if they choose to.

Pro Tips: depending on what stories themes have been covered in previous turns, you can adapt your questions to nudge players to talk about a certain theme.

- Example if you want to try getting a player to share about the community theme: You mentioned _____. Who does it remind you of?

In the End

Thank the Players/ Recap/ Wind Down

You Won! Now What?

We recommend encouraging the players to reflect on the game. Do a quick recap of the stories that were shared. Ask if anyone would like to add more to the stories.

- How did the game make you feel?
- What was your favorite moment/ biggest takeaway?

Pro Tips: Asking about facilitation feedback could also help improve the game experience when you play next time.

Pro Tips: Taking notes on the stories/ reflections shared could help expand your prompts in the future.

Pro Tip: See Section 4 for how you could expand **TangiBalls** to cater to your needs!



Don't like tic-tac-toe? No worries! You can make up your own rule for the winning state

- fill up all the tiles, have one **TangiBall** in each theme, or focus on one specific theme, your choice!
- What if everyone close their eyes when playing the game?

With the foundational elements of multisensory stimulation and shared reminiscence, you can adapt **TangiBalls** in any ways you like. Here are some inspirations:

- You can switch up the themes. Do you want to promote self-affirmation? Change the board tile categories to
 - Things I love about my self
 - Things I'm grateful for about others
 - Things that empowers me
- You can incorporate other elements into the game
 - Do you want to promote physical activity? Consider adding a movement to each theme that the players can perform together.
 - Do you want to incentivize the players with an award in the end?
- You can personalize your **TangiBalls**, or even make your own!
 - Some of the **TangiBalls**, like the snow globe, has personalization capabilities. Put your favorite picture in the snow globe to trigger cherished memories!
 - Try adding other relevant everyday items with multiple sensories – what happens when you add an orange to the **TangiBalls**?