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How can we enhance elderly health and well-being through various forms of game-based activities?

Shaojia Chen
Syracuse University

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Shaojia Chen(Max)
Syracuse University
2017 Collaborative Design

ABSTRACT

The health of an aging population is gradually turning into a topic of focus not only domestically but also internationally. The target group of this study is older Americans who are 65 and older. More specifically, elders who lack the motivation to exercise. Currently, related research has shown regular physical exercise is critical for elders to keep fit. However, participating in regular exercise can be challenging for older adults with physical limitations, and it's often difficult to motivate oneself. There has been an expanded focus on the game design intended to motivate elders to contribute to their overall well-being. Through qualitative research this project aims to understand which parts of the body require routine exercise and which game-based activities elders prefer. My goal is to design a motivational game that keeps the aging population physically fit, mentally sharp, and socially engaged. In conjunction with this research, I've designed a physical large-scale puzzle called "CubeX" as a method to motivate elders to incorporate exercise with a leisurely experience, and this activity might also serve to keep the brain active.

How can we enhance elderly health and well-being through various forms of game-based activities?

by

Shaojia Chen
B.A., Wuhan University of Science and Technology, 2015

Thesis
Submitted in partial fulfillment of the requirements for the degree
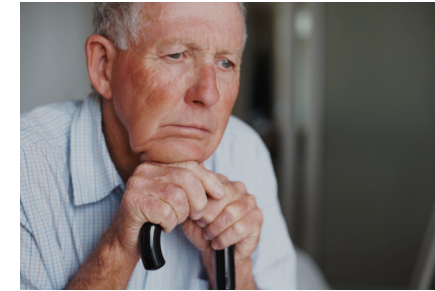of Master of Fine Arts in Collaborative Design.

Syracuse University
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Contents

01 | INTRODUCTION

Upon the discovery of demographic changes in the United States from U.S. Census Bureau, the population of Americans aged 65 years or older accounts for 14.5% of the U.S. population in 2014. By 2030, older adults will account for roughly 20% of the U.S. population and the number is still consistently growing (Ortman et al. 2-4). A significant number of people are suffering from chronic diseases and degenerative illnesses among this huge aging population. According to "The State of Aging and Health in America", approximately two out of every three older Americans had multiple chronic conditions in 2013, and 31.4% of them are lacking physical activity (The State of Aging and Health in America2013 4). A large amount of research and studies scientifically proved that regular physical activity is critical for elders to keep fit, and a lack of exercise may contribute to higher levels of physical and cognitive impairment. However, participating in regular exercise can be challenging for older adults with physical limitations, and it's often difficult to motivate oneself to exercise (Brox et al. 546).

Currently, there has been an expanded focus on the game design intended to make it more acceptable, accessible and motivating for elderly users (Fua et al. 291-297). Moreover, game-based activities hold an exceptional promise for improving the lives of elders, potentially their physical and cognitive, increasing their social connections, and, for the most part, providing them with a pleasing way to spend time. In this study, I research the needs and importance for seniors to have an appropriate amount of physical exercise daily. I also explore a number of age related factors that may affect the elderly experience of interacting with the game-based activities. In addition, I analyze the advantages and disadvantages of existing game-based activities in order to design a suitable solution that works successfully for an aging population.

02 EXPLORING THESIS TOPIC

> " Aging is not lost youth but a new stage of opportunity and strength.
>
> — Betty Friedan

Mind Map
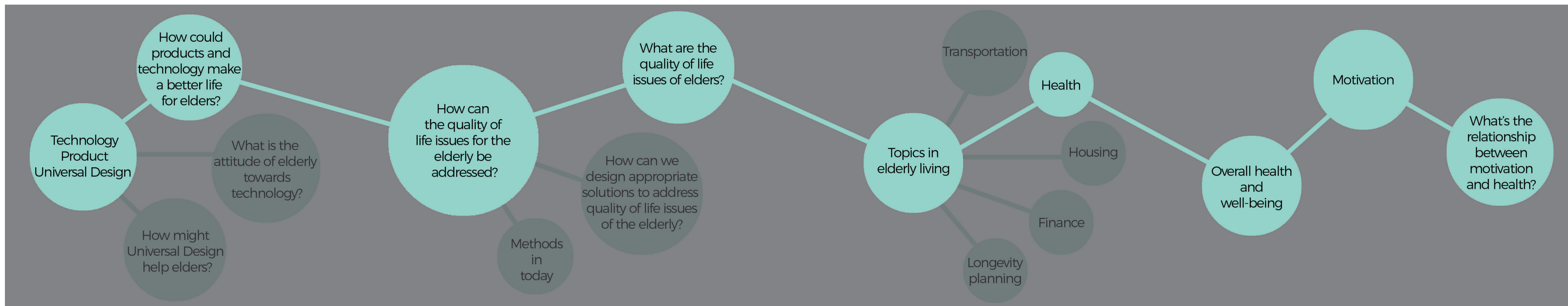
In September 2016, I started my thesis analysis and synthesis with three words — Technology, Product, and Universal Design. In the 21th Century, A lot of products associated with technology gradually becoming an irreplaceable part of people's life. Universal Design also plays a significant role in reducing barriers for a greater good. Undoubtedly, It makes younger generation's life easier. But, how about the elders?

I started to think "How can the quality of life issues for the elderly be addressed?" I then took a divergent approach this question and came up with "What are the quality of life issues of elders?" followed by "How can we use design to address quality of life issues of the elderly?"

During the initial research, I've noticed the MIT AgeLab has categorized a number of topics in elderly living where "quality of life issues" may occur. For example, they have identified transportation, housing, health, finance, and longevity planning (Research Themes & Projects). And I am personally interested in the elderly health topic.

Before I chose a direction for my thesis development, I had an interview with S. Ann Skiold who is a research librarian at Syracuse University Libraries about the major quality of life issues of older adults. She mentioned the word "motivation" in the conversation which triggered me to remember a true story of my grandma several years ago.

The Story

When I was a primary school student, I lived with my grandparents, and my parents worked and lived in a bigger city. Afte graduation, my grandparents and I decided to move to live with my parents in the city for a better education. However, we soon found out that like many other things in life, it was not quite that simple.

A few months later, my grandma began to miss her friends who lived in her hometown because she couldn't make any new friends in this different environment. I still remember in those days my grandma always sat on the couch and numbly watched TV. No social connections, no positive attitude, and no physical activities. In order to break this vicious circle for my grandma, my parents and I consistently invited her to spend time with us after dinner, but most of the time, she refused.

However, the matter was showing a turn for the better. One day, my grandma accepted our invitation and she saw a great number of people of a similar age square dancing and talking with each other at the community center. She decided to participate in the square dancing activity after dinner a few days later, and she kept up this habit for almost ten years and even to the present day.

Insight

To my grandma, square dancing is the key to the door of an entirely new world. To me, square dancing is a form of physical activity which played a significant role in motivation. This dancing activity motivated my grandma to engage in exercise, helped her to keep physically and mentally fit, and allowed her to make new friends.

In this story, I truly understand the importance of supporting elderly well-being in their later life. With age comes a decline in individual health, social connections, and physical ability (Vaillant et al. 839-847), physical activity can be powerful to benefit elderly health and overall well-being (Rejeski et al. 23-25).

Therefore, I've looked into the academic field of physical activity associated with elderly health and well-being to explore the health benefits of physical activity, current elderly health status in the US, and key factors of motivation for elders engaged in exercise.

Health Benefits of Physical Activity

Definition

Physical activity is defined as any bodily movement produced by skeletal muscles that result in energy expenditure(Caspersen et al. 126).

Benefit 01

Related research has been shown that lack of physical activity leads to an increased risk of a number of chronic diseases, including diabetes mellitus, obesity, osteoporosis, hypertension, and many others. Participating in regular physical activity has well-known benefits for lowering the risk of getting chronic disorders, degenerative illnesses, and cardiovascular disease(Chakravarthy et al. 165-173).

Benefit 02

Based on the results of observational research at the Oaks, which is a Syracuse local-based elderly independent living facility, nine out of ten participants including male and female, age range from 64 years old to 83 years old have reported that routine physical activity such as aerobic exercise (walking, dancing) and muscle-strengthening exercise(yoga, tai chi) enhance their musculoskeletal fitness (Warburton et al. 801-809).

Benefit 03

There is expanding evidence that improved musculoskeletal strength is correlated with the enhancement of overall health status and well-being (Rejeski et al. 25). Furthermore, relevant research also shows regular physical activity could speak to a significant and intense protective component for cognitive function decline and dementia diseases in elderly life (Laurin et al. 498-504).

Summary

These findings indicate that regular physical activity contributes to a remarkably reduced rate of chronic diseases. It leads to enhanced musculoskeletal fitness and possibly delays age-related cognitive loss and impairment.

Reduce rate of getting chronic diseases

Enhance musculoskeletal fitness

Protect cognitive function decline

Statistics

14.5%

The population of Americans aged 65 years or older accounts for aproximately 14.5% of the U.S. population in 2014

66.7%

Approximately two out of every three older Americans aged 65 years old and plus have at least one chronic diseases

The current health status of the elderly in the United States is not optimistic. According to "The State of Aging and Health in America 2013" report, more than a quarter of all Americans and approximately two out of every three older Americans aged 65 years old and plus have at least one chronic diseases, such as stroke, diabetes, and chronic lower respiratory diseases in 2013 (The State of Aging and Health in America 2013 6).

In addition, from the Healthy People 2020 targets for the older Americans in this report. 31.4% of them have multiple chronic conditions because of a lack of physical activity (Aungst 29-33), and 24.5% of them are struggling with obesity (Aungst 29-33).

27.5%

27.5% of American adults aged 50 years and over reported no physical activity outside of work

33.3%

By age 75, about one in three men engage in no physical activity

50%

By age 75, about one in two women engage in no physical activity

Undoubtedly, a lack of physical activity is a primary cause of chronic diseases (Booth et al. 480), and obesity also is one of the consequences. Although regular physical activity can help elders prevent, or manage many of the chronic conditions, and potentially delay cognitive decline and impairment, 27.5% of American adults aged 50 years and over
reported no physical activity outside of work.

Moreover, the physically inactive level rose dramatically with increasing age and was 26.9% among those aged 65-74 years, and 35.3% among those aged 75 years and over (Watson et al. 954-958). More specifically, from the latest report of the Centers for Disease Control and Prevention says by age 75, about one in three men and one in two women engage in no physical activity in the United States (US Department of Health and Human Services 2). Therefore, the current older American health conditions present a high volume incentive for action.

To accurately obtain the key factors of motivating elders to participate physical activity, it is important for me to discover the barriers that keep older adults away from these activities. I combined the results of the study in 1990 by Sallis, James F and Hovell, Melbourne F(Sallis and Hovell 307-330) with my conducted research at the Oaks. The most common reasons for keeping elders away from more physically active lifestyles are:

they fear being injured
they lack self-motivation
they do not find exercise enjoyable,
they have physical body limitations,
they do not have enough time to exercise,
they lack encouragement or companionship from their family and friends.

Among these reasons, not finding exercise enjoyable and lacking of encouragement or companionship from others stands for the social factors that are the dominant influences on multiple types of elderly physical activity behaviors (Sallis and Hovell 307-330).

Keys factors of motivating elders to join physical activity

As a result, in order to overcome these barriers, the fundamental approach for improving elderly attitude towards exercise is to create an enjoyable and pleasing experience while participating in physical activity.

Besides, increasing the opportunities for encouragement or companionship from family and friends, the possibly to bring in social interactions for elders during physical activity is also an essential precondition for motivation.

Exergame

Therefore, an innovative form of exercise called game-based activity or "exergame" might be a good solution to address this issue. After research, I then added several steps from my broad topic question "How can quality of life issues for the elderly be addressed?" and narrowed down my thesis question "How can we enhance elderly health and well-being through various forms of game-based activities?".

03 DISCOVERING EXERGAME

Definition

The definition of game-based activity or "exergame" is the activity of playing games that require the players to move and involve physical exertion (Ijsselsteijn et al. 17-22), such as Wii games, Microsoft's Kinect, or the PlayStation. Nowadays, there has been an expanded focus on the exergame design intended to make it more acceptable, accessible and motivating for senior users. A large number of these exergames are being played by the aging population (Brox et al. 546-549).

Hypothesis

The hypothesis is that exergames or "game-based activities" can hold an exceptional promise for improving the lives of elders, potentially enhancing their physical and mental properties, increasing their social connections, and for the most part providing them a pleasing way for spending time. I have been delving into the diversity of exergames that are used as recreation among the senior communities to see if I can gain supporting evidence for my hypothesis.

Research

For game-based activities to be encouraging and convincing for an aging population, it has to be acknowledged and accepted by the target group and also has to be accessible to the target group as well. The next part of the book represents some research about the existing exergames associated with the target group regarding acceptance, health benefits, and social engagement.

Research
related to the Wii

The Wii is a home video game console released by Nintendo. When the Nintendo Wii Fit first appeared in 2007, Wii games were not initially designed for the aging population. The product comes with various exergames like the Wii sports games (Wii bowling), and Wii fit balance board games (Wii Fit) and requires players to play with Wii remote controls equipped with motion sensors.

A large amount of research has been conducted with senior player interacting with various Wii games. The Wii bowling game has been regarded as a suitable exergame because it allows senior players to take their time when it's their turn (Brox et al. 546-549). Interestingly, older female players are more likely to play quick-reacting sporty Wii games including tennis, boxing, and sword fighting.

However, researchers also noticed that it was not easy for senior to operate the Wii system and play the Wii sports game, but senior players do reflect that Wii Sports had a constructive social effect between game participants (Ijsselsteijn et al. 17-22).

They also enjoy that when they play the Wii games, it stimulates them to be physically and socially active. A researcher Shubert also found the fact that many older adults were interested in trying Wii games if it could benefit their health (Shubert 27-32).

There is a study that was conducted in Singapore in 2009 (Theng et al. 10), and it shows Wii games had a high acceptance among the aging population. There were over 50% of the total amount of participants over 60 years old, but it does not clearly show each demographic distribution of the senior participants and which Wii games were played.

Research related to the Microsoft Kinect

Microsoft's Kinect is described as a "motion-sensing input device" for the Xbox 360 gaming Console. Unlike the Wii remote from the Nintendo and PlayStation Move from Sony, the Kinect enables users to interact with Xbox 360 games and applications without the need for a controller. By tracking the user's body movement, it allows Kinect to receive and project the motion trail through its user interface.

There are approximately 100 Kinect-enabled Xbox 360 games have been released in July 2012 (Boulos 326-330). Including a series of exergames such as adventure games (Disneyland Adventures), body motion-controlled car racing games (Kinect Joy Ride), musical dancing games (Zumba Fitness Rush), formal fitness workout games (UFC Personal Trainer), and sports simulation games (Tiger Woods PGA TOUR 13).

Exergamers Wellness Club in LA

A program held by Microsoft and the City of Los Angeles in April 2012 (Exergamers Wellness Club Uses Kinect and HealthVault to Enhance Seniors' Well-being).

In the Exergamers Wellness Club, they use Kinect for Xbox 360 games to help seniors who at the St. Barnabas Senior Center stay fit and have fun.

The age range of senior citizens at the St. Barnabas Senior Center is from 60 to 80 years old, and the Kinect-powered interactive sports games, particularly bowling and dance games meets the overall elderly preference (Ganesan et al. 2297-2302). Senior participants in the program reported the Kinect Xbox 360 exergames help them to improve mood, keep physically fit, and engage into social connections.

Research related
to the Sony PlayStation

PlayStation is a motion/handheld game controller developed by Sony. It initially released in 2010 for use with the PlayStation 3 system, then evolved to cooperate with the PlayStation 4 in 2013, and the PlayStation VR platform in 2016.

The working theory of PlaysStation Move controller is conceptually similar to Nintendo's Wii remote. The controller uses inertial sensors in the wand to detect motion while the wand's position is tracked by using PlayStation Eye or Camera.

Games from the PlayStation Move such as "Move Fitness," and "Get Fit with Mel B" are indicative of a growing number of game-based activities and exergames that actually can provide benefits for players to stay physically fit and increase the mobility of elderly (Maroni and Skjæret 18).

The EyeToy in
PlayStation 2

EyeToy is a Sony PlayStation-based game which was released in 2003 for the PlayStation 2 platform. A case study conducted by researcher Flynn, Palma, and Bender in 2007 (Flynn et al. 180-189) aims to explore the feasibility of using EyeToy for the rehabilitation of a 76-year-old individual for two years post-stroke. After 20 sessions of the one-hour play section experiments, the elderly participant determined a clinically rated enhancement in the Dynamic Gait Index, growing from 16/25 pre-intervention to 21/24 post-intervention.

Another research effort conducted by Yavuzer, Senel, Atay, and Stam in 2008 also shows that compared to a conventional stroke rehabilitation program, the PlayStation EyeToy exergame can contribute to a relatively compelling advancement in functional impairment recovery. Besides, in additional research, both healthy elders (average 70 years old) and elders who in the acute and chronic stages of recovery (average 63 years old) reported a high level of engagement and amusement in playing PlayStation EyeToy game (Yavuzer et al. 237-244).

Summary

Based on the research into the Wii, Microsoft's Kinect, and Sony PlayStation, there has been a huge amount of research that provides substantial evidence to prove exergame/game-based activity can help older adults to improve their heath status, social connections, and offer them a delightful way to spend time. From these studies, older adults are more likely to play with sports games such as bowling, tennis, and dancing game to get benefits for their physical health and well-being. Currently, there is not much corresponding evidence from research to verify that these sport-based exergames can improve elderly mental health as it helps their physical health (Arntzen 63-67).

" The part of my body that needs the most exercise is the brain. "

Inspiration

A quote from an 83 year old female participant from my research inspired me to start barnstorming an appropriate game for physical activity that benefits not only elderly physical health and social well-being but also improve mental health as well. According to the LoveToKnow Seniors, except sport-related athletic games, card games like Pinochle, and board games like Bingo, Jigsaw Puzzle can also keep seniors entertained (Woolman 1).

Game Content Research

Idea selection for this game-based activity was based on the combination of the motivation to play with the benefits of play the game for older adults. As mentioned before, an enjoyable experience while participating physical activity, increased companionship and social engagement are essential. Knowing the benefits that game-based activities can offer is an additional motivational factor for starting and keeping the habit of participating it (De Carvalho and Ishitani 19-28).

Based on the secondary research results of elderly game preference and comparison to other games, I decided to apply the jigsaw puzzle game concept into my initial game-based activity design. I chose it because jigsaw puzzle games are relatively popular among older Americans (Cota et al. 96-105), and its powerful healing benefits for elders.

Jigsaw Puzzle

There are quantifiable benefits of carrying a jigsaw puzzle game activity into adulthood, like the notable MacArthur study (Albert et al. 578), have shown that keeping the mind active with jigsaw puzzles has remarkable advantages. Mind-flexing activities can lead to a longer life expectancy, a better quality of life, and reduce the chances of developing certain types of mental illness, including memory loss, and even Alzheimer's Disease (Lee 11-34).

During the puzzle game, the left brain hemisphere, our analytical side, sees all of the separate pieces and attempts to sort them out logically. The right brain hemisphere, our creative side, sees the "big picture" and works intuitively. Both types of thinking are required in order to piece the puzzle together successfully. However, the next challenge is how to design a jigsaw puzzle-based activity to stimulate elders' movement while thinking.

Giant games

The definition of game is "a form of play or sport, especially a competitive one played according to rules and de-cided by skill, strength, or luck". During the brainstorming section, I accidentally found one of the active activities for seniors called "Giant Games" (Kay 4). The theory of the giant games like giant chess are conceptually similar to those exergames on the current market I've discussed above. Unlike the digital exergames, the giant games are relatively low-tech instead of high-tech. The concept of making games into a giant version by using proper mate-rials can work perfectly for any board game. It inspires me to start thinking about designing a classic jigsaw puz-zle into the giant version.

04 |NITIAL DESIGN

Brainstorming Pin Up

Interactive Puzzle

Projector For Game

Play Zone
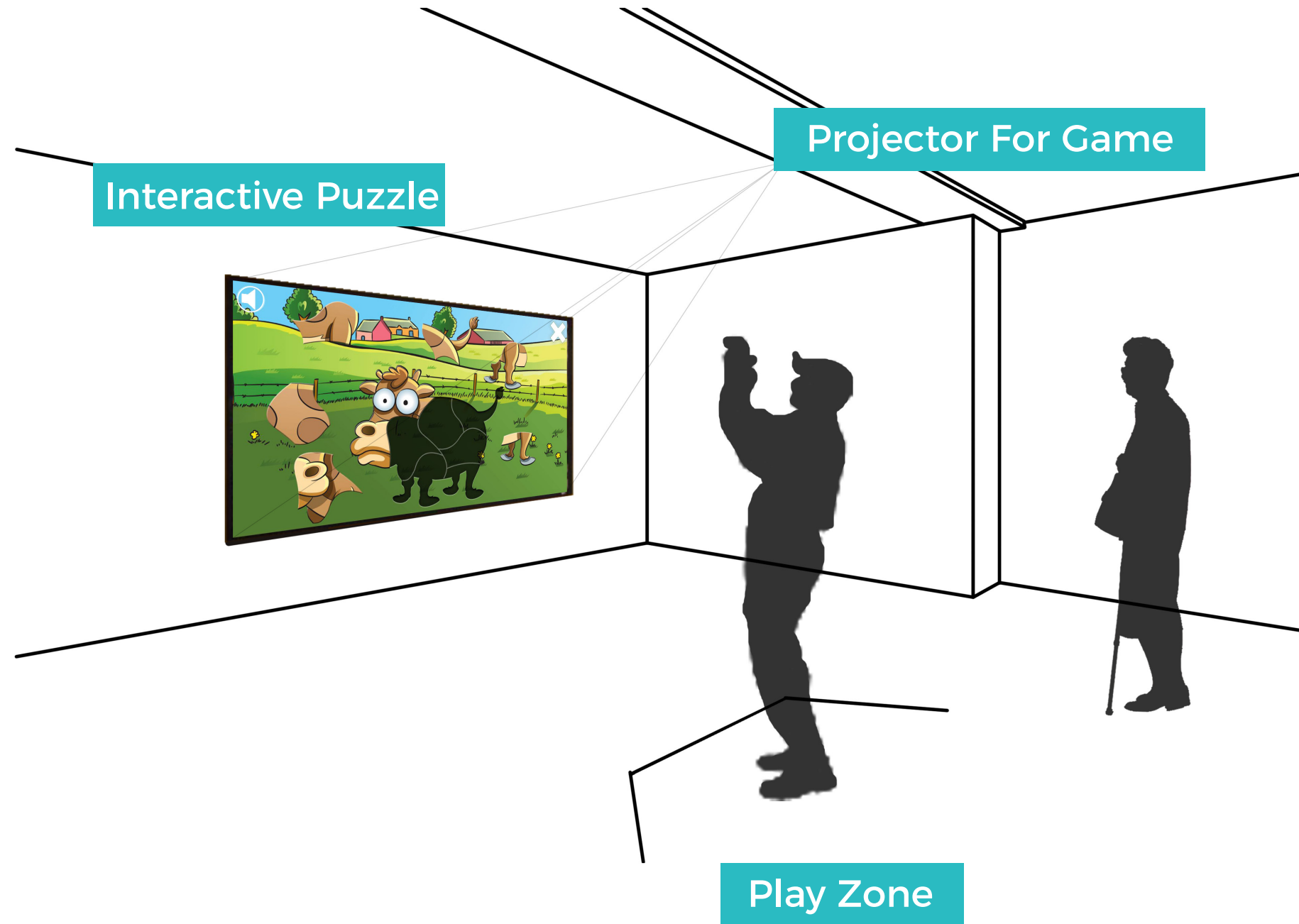
Digital platform jigsaw puzzle

My first game-based activity idea was a digital platformed jigsaw puzzle. The idea was to enlarge the traditional jigsaw puzzle to an appropriate size that requires elderly players to then engage in a large range of body movements to complete, using the projector to project or using TV to display the puzzle at an accessible height against the wall and motion sensors to capture motions when they play. The two white cursors shown in the game represent the players' two hands. The game also needs to be designed so as to provide multiple levels of difficulty to accommodate elders with varying degrees of cognitive decline. In addition, players can either stand or sit to play.
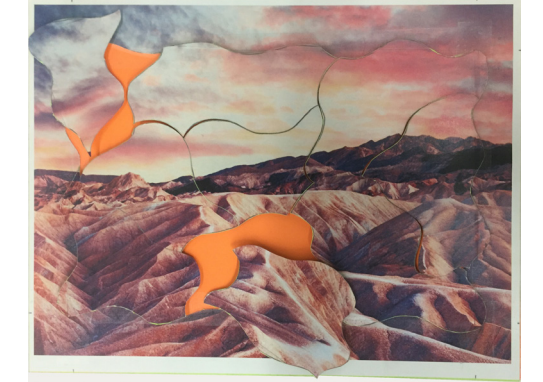
The Grand Canyon National Park

Initial Idea 02

Multi-Difficulty Levels

Physical platform jigsaw puzzle

My second game-based activity idea was to create an over-sized physical platformed jigsaw puzzle. The idea is similar to the digital one, to modify the classical jigsaw puzzle into an appropriate size for elders to interact with. With help from Karen Smith, who is a licensed physical therapist from Syracuse, Karen helped me to determine that the length of the puzzle itself should not exceed 3 feet. As a result, the final size of the puzzle game is 48 inches wide and 30 inches long, and it supposed to be hung on the wall to motivate seniors to get exercise when play. I used the recommended magnet dots instead of velcro dots on the back of the puzzle pieces and the puzzle frame to make the game-based activity more accessible to the target group. In addition, I designed three levels of difficulty from easy to hard based on my research into puzzle design. All levels keep the same amount of puzzle pieces. The entry level is nine rectangle shape pieces, the middle level is nine wave shape pieces, and the hard level is nine randomly formed and sized pieces. I initially chose the entry level for my giant jigsaw puzzle prototype and brought it to the Brown Bag Lunch event in February 2017 to solicit get feedback and suggestions from resident experts at the Aging Studies Institute.

05 ASKING FOR FEEDBACK

ASI Brown Bag Lunch
Collaborative Design Thesis Investigations

February 10, 2017

Brown Bag Lunch Reflection

The Brown Bag Lunch event was hosted by the Aging Studies Institute and the Collaborative Design Program at the Syracuse University in February 10, 2017. To create a productive and interactive conversation with the guests, I decided to show some of my preliminary mock-ups of multiple games as my research method examples during the event. Besides, I also brought one of my inital design idea — physcal wall-scale jigsaw puzzle game to the Brown Bag Lunch in order to gain some feedbacks.

Feedback 01

Although it was a one and half hour event, I received a lot of valuable feedbacks from the Brown Bag Lunch event. For example, someone mentioned that the wall-scale jigsaw puzzle or my final design delivery should be moved up and down while hanging on the wall for accommodating older adults who are standing/sitting and with different heights as well. Therefore, adjustable height is a highly important feature that I need to put it into my consideration towards final design development.

Feedback 02

Besides, I also received some encouraging feedbacks from the guests about the social benefits and intergeneration aspects of my potential design idea. Although the target group of my thesis is the an aging population, and my primary goal is to develop a game-based activity to motivate older adults to be more physically fit, get potential benefits for their cognitive well-being, and create social interactions while playing as a group. One of our guests pointed out the possibility of transferring the concept from my potential deign idea into the creation of intergenerational game-based activities, so that not only the game-based activity can have potential benefits to elder's physical functions, cognitive functions, and social well-beings, but also can build a bridge to strengthen the connections between multi-generations.

Feedback 03

Moreover, when I was thinking about how to change the difficulty of my game-based activity, I always started by thinking how to change the game itself. I received a suggestion from our guests related to game difficulty changing. The guest suggested that I change the rules of how to play the game-based activity instead of changing the game itself during the Brown Bag Lunch. Take my wall-scale jigsaw puzzle game as an example. She suggested that I deliver the puzzle pieces to participants from multiple directions instead of one direction. Besides, appropriately increase the distance between the jigsaw puzzle game and participants instead of standing right in front of it while they are playing. It is also an effective way to set multiple challenges and achievements progressively.

Feedback 04

Last but not the least, I received some good feedbacks about my physical wall-scale puzzle from the CHAT(Community Health and Aging Team) group at Ecovillage. One member of the CHAT group told me that the form of the game-based activity could also be developed as a pre-diagnosis method for family members, caregivers, and doctors to monitor elderly physical and cognitive functions. Besides, it could help them to take actions in the early stage to prevent elderly health status getting worse.

06 PRIMARY RESEARCH

The Oaks at Menorah Park

IRB Approval

An institutional review board, known as IRB. In order to start my primary research and design a game-based activity idea from the research, I needed to get my IRB application approved(see more details at the back of the book).

The reason why I needed IRB approval was that the primary purpose is to protect the rights and welfare of the human subjects, This means people who are planning to do research involving human subjects need to submit an application to the IRB and receive approval before they can start recruiting subjects or collecting any data. Without this approval they may not be able to use data collected from their research. Fortunately, my IRB applicant was approved by the committee in March 2017, and I began my primary research in a locally-based independent elderly living facility — The Oaks.
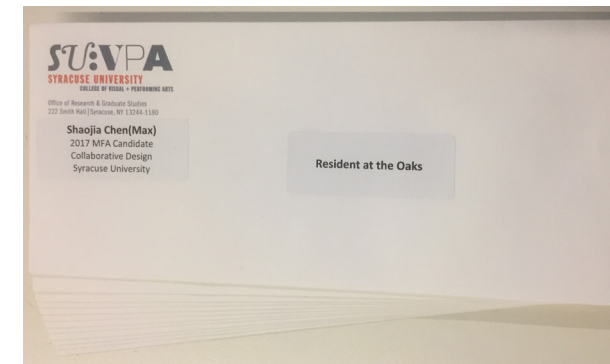
Recruitment

I printed copies of my recruitment letter along with a consent form that came along with a Syracuse Universiy VPA(Visual and Performing Arts) branded envelope for potential participants. I started my research recruitment with a verbal presentation about my thesis topic to the residents at The Oaks at Menorah Park. After the presentation, I scheduled many individual face-to-face sessions to provide additional details with to the residents that were interested.

With the help from Judith Huober, who is the director of the Syracuse Jewish Family Service and director of the IMPARA(Institute at Menorah Park for Applied Research on Aging), and Patricia McGregor, who is the director of the Oaks. I recruited 10 participants in total who signed the consent form and were willing to join my research.

Research Method

Survey

Part 01

First, the survey contains ten basic questions, such as what is your age, what form of physical entertainment do you often take part in, how often do you take part in, and how often do you use the smartphone to tablet. It aims to know the demographic distribution of my research participants, their physical activity form preference, and their attitude towards a high-tech lifestyle.

Card Sequence Activity

Part 02

Second, I asked participants to sort all game cards in an logical order that represent their game preference from high to low. The game cards set contains 15 cards from different senior game categories, including card games, board games, digital exergames, and outdoor sports games. It aims to explore elderly participants' game preference.

Game Activity & Observation

Part 03

Third, the activity section is placed in the Oaks. There are four sections in total, and one hour for each section. I designed a Move & Guess game similar to the charades game in both digital and physical platforms. Unlike the traditional charade game, all the words in the Move & Guess are related to sports or any other action like watering flowers, or making pizza, that require senior players to make the corresponding motion to let others guess correctly. The word card set of physical form move & guess game was simply made of cardboard, and the digital form move & guess was built in an iPad. Therefore, I brought four games to the 10 participants —the digital/physical giant jigsaw puzzle on the wall and the digital/physical move & guess. After telling participants the play instructions for every each game, I give participants options to play individually or play in a team and let participants to freely choose the game to play, then end up playing all the games. My responsibility during the activity section was to observe elderly participants when they played each game. The goal is to deeply understand which part of the elderly body need regular physical activity and make a comparison of participants' reactions and attitude towards the different games and different platform.

Individual Interview

Part 04

Last, after all the participants finished the activity section, I scheduled one-on-one feedback interviews with each participant individually aims to get constructive suggestions and feedback from the participants for improvement, and to gain insight from each game as the cornerstone of my final design.

Research Findings and Analysis

10 Participants
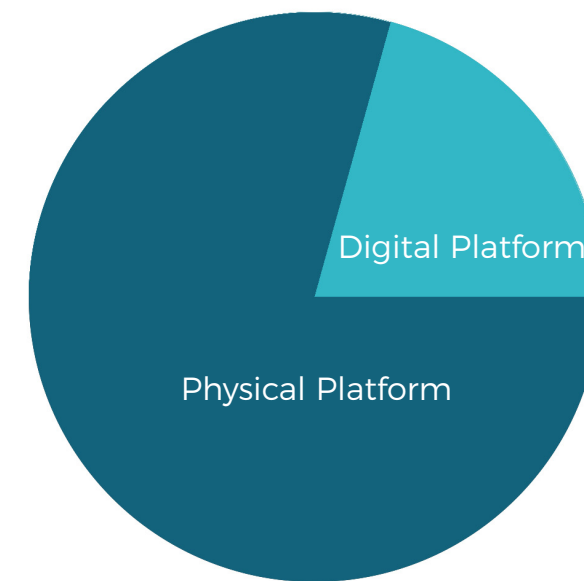
76 Avg. age

70% Low physical active level

Ball Games
Card Games
Digital Games
Board Games
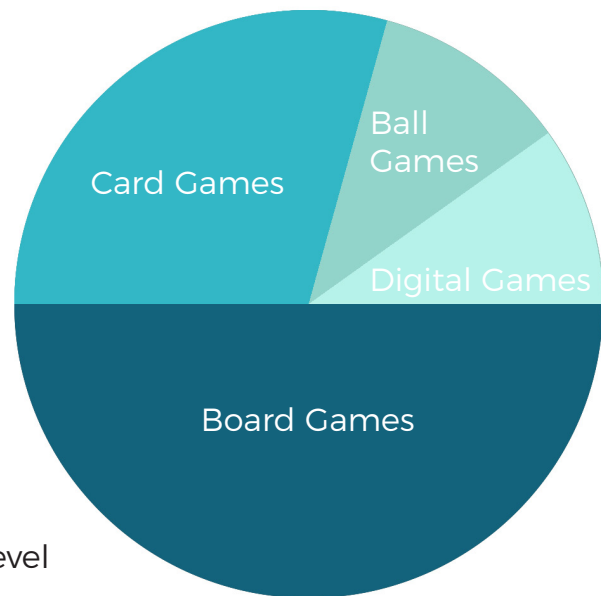
5 Prefer board games

3 Prefer card games

1 Prefer chess games

1 Prefer Wii games

There are ten elders participating in this research including two males and eight females, the youngest participant is aged 64 years old, and the oldest participants is aged 83 years old. The average age of this elderly participants group is 76 years old. Surprisingly, based on the survey results, there are more than half of the participants are not at recommended physical active levels (participate physical activity only once or twice a week). Moreover, one of the participants even barely does exercise (attends physical activity less than once a week). My primary research findings of why they keep in a low physical active level match with the results of secondary research. Some participants said they think physical activity is boring and it is hard for them to keep doing it, and other participants said it is difficult for them to join physical activity without any encouragement or companionship. Besides, one participant told me when she was around 50 years old, and she used to participate in a regular physical activity class for two years. But, she didn't felt any positive change to her body. She gave up on physical activity since then. In addition, the elderly participants' favorite physical activity format is aerobic and endurance exercise which is comparatively relaxing than other types of activity.

Digital Platform
Physical Platform

8 Prefer physical platform

2 Prefer digital platform

60% Prefer puzzle
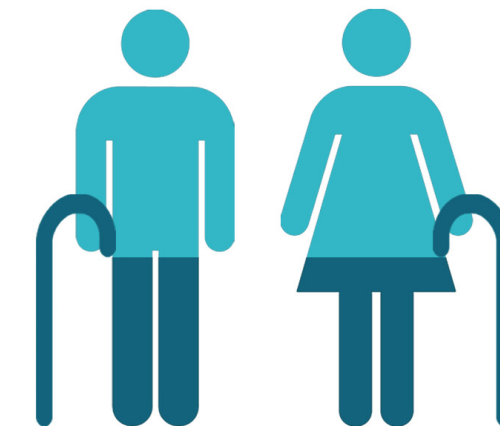
7 Need exercise upper body

During the game cards selection section, there are three out of ten participants liked card games(Charade, Mahjong, Pinochle), five participants liked board games (Jigsaw puzzle, Bingo), one male participant liked playing ball games, and one female participant who was 64 years old was strongly interested in digital exergames. This elderly game preference finding matches up with the results of my secondary research again. From observation of activity sections, I found they quickly got tired when they try to reach/place the top three pieces to the puzzle board or similar motions that require them to raise their arms. Furthermore, when they signed the consent form, tried to pick up charade cards, tablet, and puzzle pieces, some participants' hands became shaky. I realized the part of the elderly body that most requires regular exercise is their upper body. More specifically, their arms, hands, and fingers. Additionally, elderly participants are more likely to try the physical puzzle and charade initially and then start to learn the digital versions. It also shows that participants prefer low-tech forms of game-based activity than high-tech, but this preference is strongly related to their age.

After the feedback interviews, participants are more likely to want to play the giant jigsaw puzzle game because it is easy to access and play for any age group. Although most of the participants think charades is a fun game to play, they believe the jigsaw puzzle game has greater power to improve their cognitive functions than the charades. When I finished conducting my research in the Oaks, an encouraging news heard from one female participant who barely does enter physical activity before. She said she will always look forward to joining the game-based activity again. In conjunction with my primary research and secondary research, I decided to combine the jigsaw puzzle game concept with the giant game concept for my final design direction.

07 FINAL DESIGN

Design Thinking



The Grand Canyon National Park
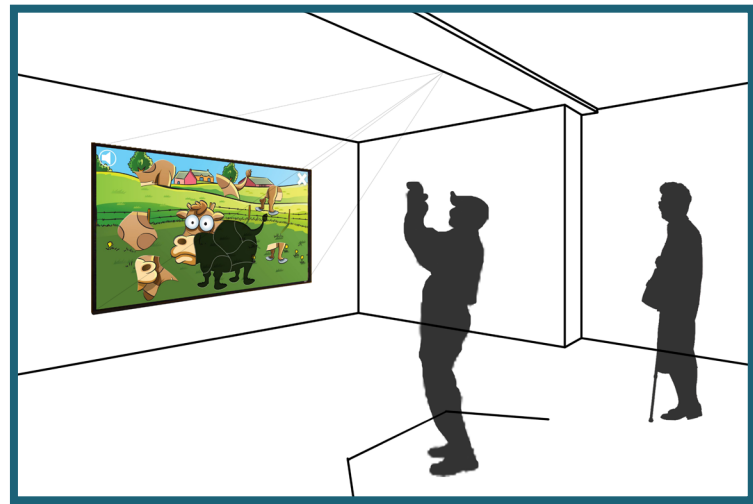
Compared to the digital software platform exergame, the physical product platform game-based activities have a lot of advantages. They are easier and simpler for seniors to access and interact with. They also have the possibility to become an outdoor activity, unlike the digital one, which has to be indoors. Besides, the price of a physical game-based activity will also be relatively low compared to a digital software exergame. But, the physical form activities still have some disadvantages. They are comparatively hard to move or carry, appropriate spaces are required to play or store them, and it is also difficult to adjust their size or shape to accommodate the diversity of seniors with various special needs once they have been produced from the manufacturer. Last but not the least, the major issue of the physical platform game-based activity is its simple game patterns. Obviously, one of the prominent advantages of digital software exergames is they have much more complex game patterns than the physical platform. For example, if a large-size physical platform puzzle activity only has one background image, the elderly players will possibly get bored with it after they participated in the activity three or four times.

Prototyping
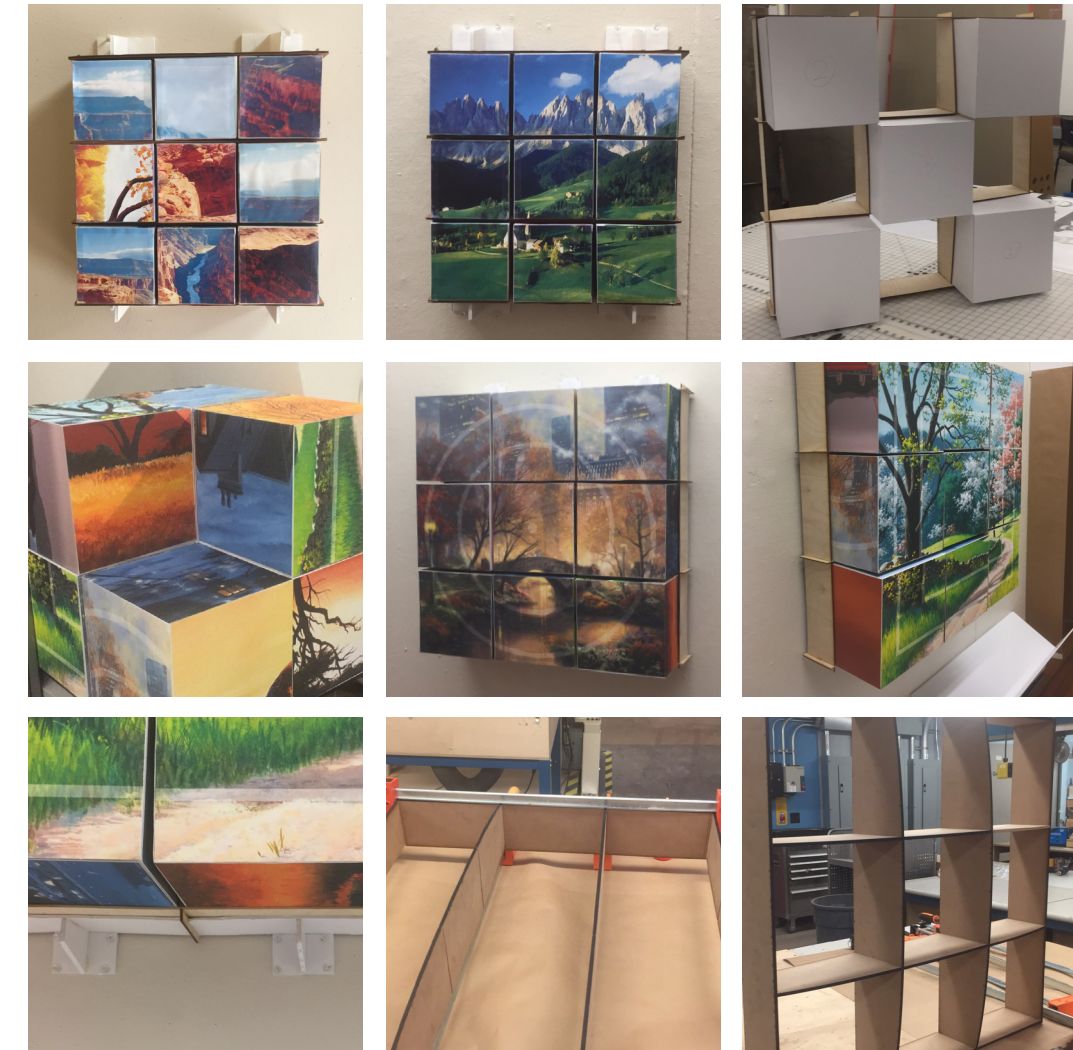
In order to enrich the pattern of the game-based activity but still keep the physical platform that allows elders to easily access and play, I came up with an idea about using a cube shape as the puzzle pieces. It has six sides, which means the puzzle game can have six different background images. I designed a frame for containing nine cubes in total to complete background pictures with multiple difficulty levels for the puzzle game. In addition, I built a consistent cube holder underneath the frame for holding the cubes. I made two prototypes and one final design model.
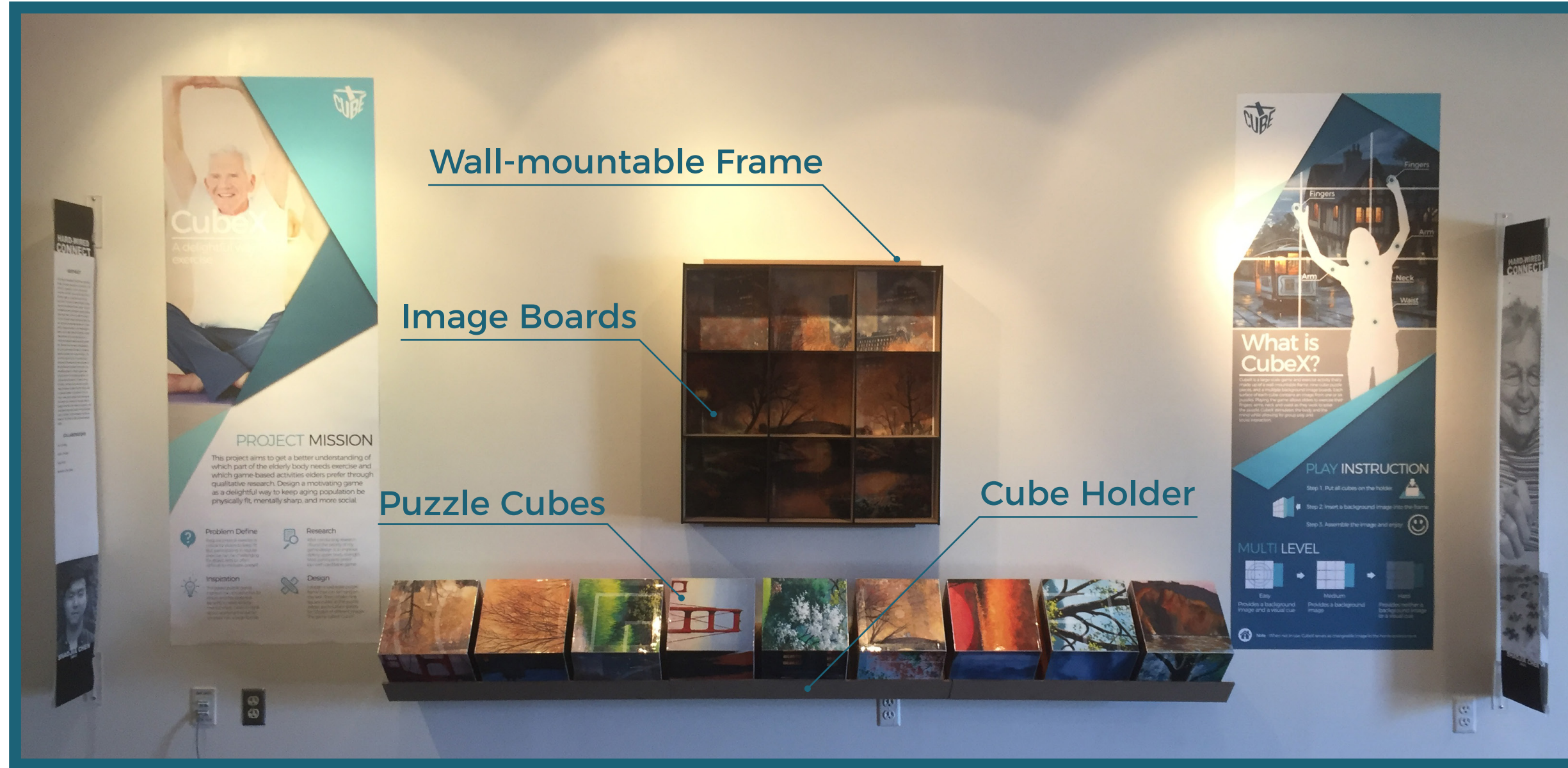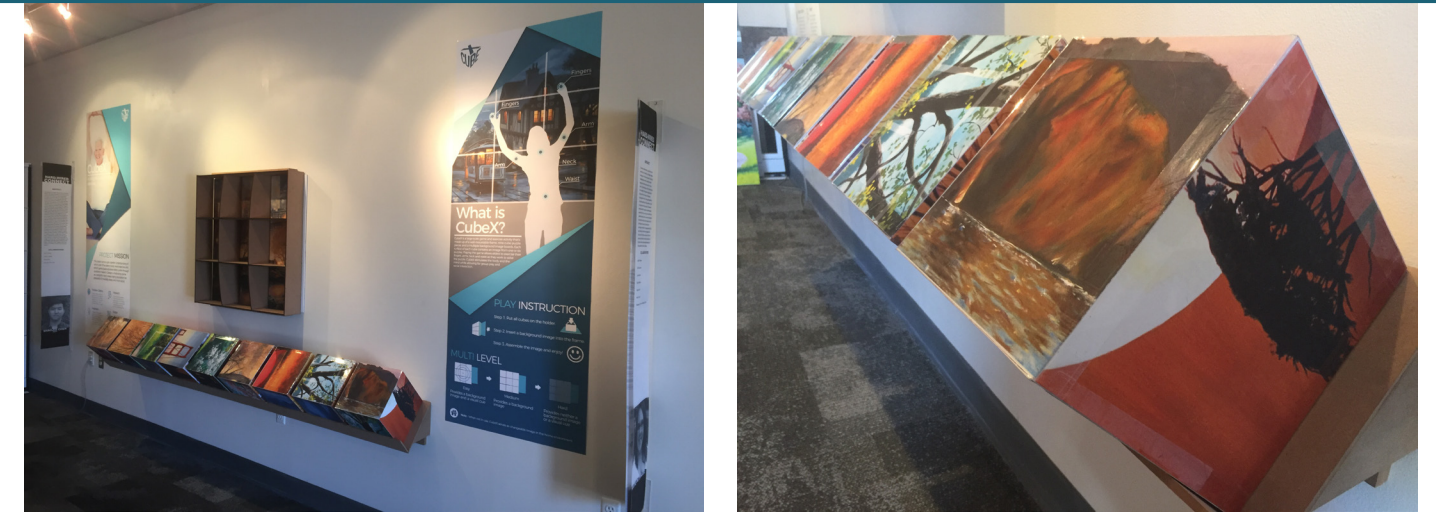
CubeX

Wall-mountable Frame

Image Boards

Puzzle Cubes

Cube Holder

My final design is called "CubeX". CubeX is a large-scale game and exercise activity that is made up of a wall-mountable frame, nine cube puzzle pieces and multiple background image boards. Each surface of each cube contains an image from one of six puzzles. Playing the game allows elderly players to exercise their fingers, arms, neck and waist as they work to solve the puzzle. CubeX stimulates the body and the mind while allowing for group play and social interaction.

Play Instructions:
Put all cubes on the holder
Insert a background image into the frame
Assemble the image and enjoy

Multi levels:
Easy level: Provides a background image and a visual cue
Medium level: Provides a background image
Hard level: Provides neither a background image nor visual cue

Features

Feature 01

Each cube is 10 x 10 x 10 inches, so they are large enough for older adults to engage with even if they have some level of visual impairment. Based on the suggestion of the local physical therapist from Syracuse, I decided to make the cube out of foam board, which is a good material that allows an appropriate weight for elders and lets their fingers and hands get exercise when they hold, grab, and pick cubes.

Feature 02

The wall-mountable frame was made out of MDF(Medium Density Fiberboard) which is a high grade, composite material that allows better stability. The distance between the frame and the ground can still be adjusted after the frame is mounted on the wall. This frame aims to accommodate elderly players with either standing or sitting position.

Feature 03

Although the holder was designed to hold cubes before and during the game-based activity, and the wall-mountable frame was designed to contain the cubes. I intentionally placed the holder underneath the frame, and even a bit lower, and adjusted the frame to be a bit higher than the average level. By doing this, it stimulates elders to do bend down motions when they are trying to grab the cubes from the holder, and requires elders to raise their arms, hands, and even their head frequently when they are trying to put the cubes into the frame to complete a puzzle.

Feature 04

Moreover, because of the enlarged puzzle game size, when elders stand close enough to interact with the game, they may not be able to see the whole image. As a result, It may trigger elderly players to move forward and backward multiple times to have some full body motions.

Feature 05

The selection of background images for the CubeX game was based on the results of my primary and secondary research. The results show that when selecting puzzle images for older adults, the image should not be too childish like a kids cartoon (Koster 14-17). The research participants like simple pictures, like pets or flowers, and comparatively complex images like landscapes. I also chose some images with vintage subjects like cable cars from the past that elders from that time would be familiar with. In addition, I selected some images with famous landmarks such as the Golden Gate Bridge in San Francisco and Central Park in New York City that might trigger elders to recall memories if they been to there before.

Regarding how to distinguish the six different sides, I applied the color concept of the Rubik's cube for my image selection in order to avoid causing additional confusion to elders while they are playing. I chose six images that each has its distinct theme color. For instance, the sunset stands for orange, and the trees stand for green. Last but not the least, I used color paintings instead of actual photos because the paintings can create a greater emotional response than photos (Houts et al. 173-190). Additionally, when not in use, CubeX serves as a changeable art piece in the home environment.
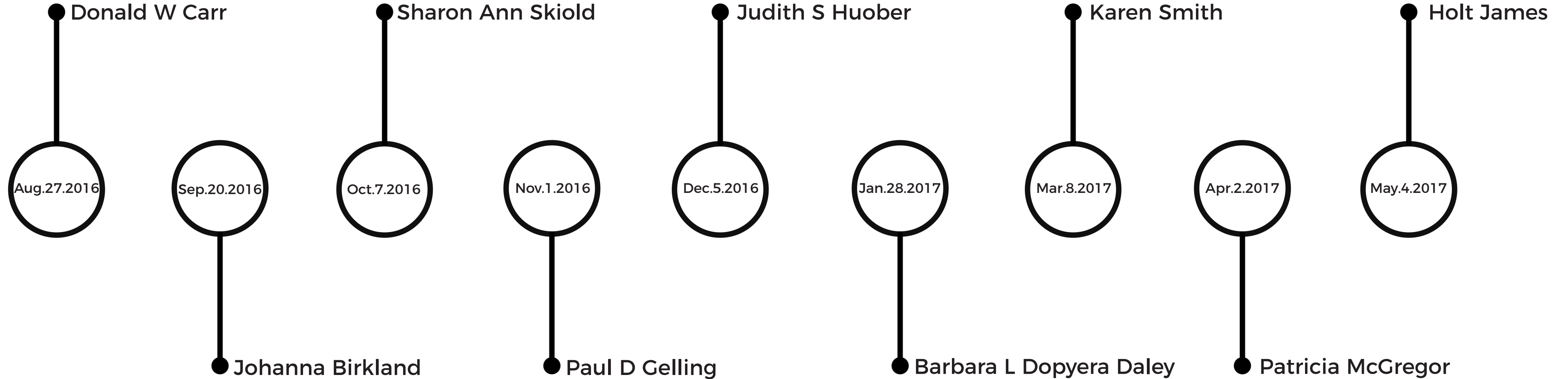
08 FUTURE DEVELOPMENT

Although my final design was completed in April 2017, my hope is that I will be able to do further development for CubeX to make it better. Currently, my design is part of the 2017 MFA thesis exhibition and is displayed at the Syracuse University 914 Works gallery. During the exhibition opening, I received a number of remarkable coomments from visitors. One of the guests suggested that I should design an adjustable weight feature for the cubes so that their weight can gradually be increased to create suitable challenges and goals for elders to achieve. Another suggestion was to a build in a sound effect function so that elderly players will get immediate notice by sound when they've placed the cube into the frame either correctly or incorrectly, and when they've completed a puzzle successfully. These suggestions show that a good design is a work-in-progress.

09 CONCLUSION

Both participating in exercise and enjoying oneself are positive factors in designing game-based activities. The "CubeX" game-based activity can be a potential tool for improving the attitudes of the elderly towards physical activity because it motivates elders to be more physically fit, mentally sharp, and socially engaged. Although currently, game-based activities cannot be a replacement for traditional physical exercise, it could be a productive alternative for elders to get started in participating in physical activity. My hope is that Game-based activities may become a game changer one day.

Design Collaboration

Donald W Carr

Sharon Ann Skiold

Judith S Huober

Karen Smith

Holt James

Aug.27.2016

Sep.20.2016

Oct.7.2016

Nov.1.2016

Dec.5.2016

Jan.28.2017

Mar.8.2017

Apr.2.2017

May.4.2017

Johanna Birkland

Paul D Gelling

Barbara L Dopyera Daley

Patricia McGregor

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School of Design
211 Lafayette Rd, Apt 111
Syracuse University
Syracuse, NY, 13205

Tel: (315) 802-8489
Email: schen144@syr.edu
https://www.shaojiachen.com

EDUCATION

Master of Fine Arts, Collaborative Design, Syracuse University, Syracuse, NY.
Master's Thesis: *How can we enhance elderly health and well-being through various forms of game-based activities?*. August, 2017.

Bachelor of Arts, Industrial Design, Wuhan University of Science and Technology, Wuhan, Hubei. May, 2015

REFERENCES

Donald W. Carr, Professor, School of Design, Syracuse University, Syracuse, NY 13244. Tel: (315) 443-0355, email: dwcarr@syr.edu

Sarah G. Redmore, Associate Professor, School of Design, Syracuse University, Syracuse, NY 13244. Tel: (315) 443-2455, email: sgredmor@syr.edu

James Fathers, Professor, School of Design, Syracuse University, Syracuse, NY 13244. Tel: (315) 443-2455, email: jwfather@syr.edu