

**Design Research for Instructional Graphics:**  
**A Focus on Fall Prevention Exercises for Older Adults**

by

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## ABSTRACT

Falls are a major cause of injury in old age and the leading reason for loss of independence. Regular exercise lowers the risk of stair falls among the elderly. Although multiple studies suggest that older adults should develop exercise plans, the elderly display little motivation towards these programs. The objective of this interdisciplinary research is to explore the role that design research can play in increasing seniors' motivation towards physical activity, by creating recommendations for engaging exercise instructions that could help to prevent future falls. In order to investigate the role of design elements in exercise instructions for senior adherence, mixed research methods were utilized: fitness class observations, interviews with experts in physical activity, interviews with seniors taking part in fitness classes, diary keeping of senior daily routines, artifact and prototype evaluation. The key findings of this research include the importance of designing exercise instructions for seniors that: include appropriate figure representations; acknowledge the benefits of exercise adherence; and take advantage of the positive opportunities for exercising while multi-tasking. The findings resulted in design recommendations for exercise instructions that, when applied, could enhance engagement and motivation towards physical activity. Designers may use the findings from this research study as a guide for designing instructional graphics that contribute to motivating and engaging seniors in fall prevention exercise.

*Key Words: Instructional Graphics Design, Exercise Instructions, Design Research, Seniors' Fall prevention*

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## CHAPTER 1—INTRODUCTION

Falls results in significant disability and mortality among seniors. One in three Canadians over the age of 65 will fall once every year (World Health Organization, 2008). Falls are the main reason why older adults lose their independence. Due to the increasing senior demographic, minimal support from the younger generation, and the limits of the health care system, the elderly need to stay independent as long as possible. Muscle weakness and impaired balance are risk factors underlying many falls and fall injuries experienced by seniors. These areas have been identified as modifiable factors that can be reduced by physical therapy (Haada et al., 1995) and structured exercise treatments. To live independently, seniors need to remain fit and physically active.

It has been established that the senior demographic is involved in less physical activity due to lack of motivation and engagement. In order to prevent future falls, there is a need to help seniors regain motivation towards regular exercise. Additionally, there aren't available and feasible exercise programs accessible to all seniors, to encourage motivation towards regular exercise. Therefore, this thesis looks at how appropriate design can contribute to fall prevention by investigating design criteria for exercise instructions that motivate seniors.

### **Research Framework**

The principles underlying the design of fall prevention instructions are defined by three inter-related research areas. The first of these is the area of independence and falls for older adults. As noted, there is a need for seniors to remain independent but at the

same time falling and fear of falling can reduce the chance of independence. Also, decreased independence is closely associated with limited physical activity that leads to muscle deterioration and decrease in balance levels (Chamberlin et al., 2005; Scheffer et al. 2008). Understanding the factors behind physical activity becomes important for the development of this research. For example, since physical activity can improve muscle weakness in the knees and balance impairments (Haada et al., 1995) this is reasonable starting point for identifying preventative measures for falls.

The second area focuses on fall prevention and exercise for older adults. It has been established that early on regular exercise can be a preventative measure for the risk of falls. Also, it has been found that seniors experience lower levels of physical activity due to lack of motivation. This lack of motivation leads to minimal levels of physical activity, which can be a major cause for falls and loss of independence. This lack of engagement calls for a design strategy to rejuvenate motivation among the senior demographic. It has been noted that individuals can become motivated by visually pleasing products, such as aesthetically pleasurable instructions. Designing instructional graphics for fall prevention exercise seems to be a reasonable preventative measure.

The third area is the appropriateness of the instructional design for the senior population. Instructional design that is visually appealing and pleasurable can create motivation among seniors to follow through with regular exercise. This regular exercise can be a preventative element for the risk of future falls. Therefore, it becomes important to have knowledge about design elements that are geared towards the senior demographic which introduce pleasure and engagement.

Taken together, these three dimensions of the research framework for this study can contribute to understanding the problems and the opportunities for the design of motivating fall prevention exercise instructions. For example, decrease in physical activity can be due to fear of falling; this leads to decreased muscle strength and balance, which eventually leads to falls. Fall prevention exercise can help regain that loss. Lack of motivation as well as not having access to affordable exercise routines becomes a barrier to doing fall prevention exercises, which also makes a person vulnerable to a fall experience. In order to take part in physical activity, there is a need for motivation and engagement that can be provided, in part, by appealing exercise instructions.

Therefore, the three areas of senior independence, physical activity, and instructional design are inter-related. In order to develop recommendations for exercise instructions for preventative measures for senior falls, researchers need to have a better understanding of each area.

### **Background & Needs**

In many studies, fear of falling has been associated with mobility impairment and activity restriction. Higher levels of fear can also contribute to reducing gait speed, balance issues and loss of muscle mass that appear to be the most significant causes of falls in the elderly (Bulat et al., 2007; Rochat, 2010). The literature suggests that there is a connection between exercise and fall prevention, and that programs focusing on balance have been shown to be effective in improving gait and reducing falls (Haada et al., 1995; Campbell et al., 1997; Bulat et al., 2007). Based on Zak et al.'s study in 2009, the loss of muscle strength and functionality in the elderly is reversible with physical training,

(Barnett et al., 2003; LaStayo et al., 2003; Zak, Swine, & Grodzicki, 2009). Given this knowledge there is a need for developing fall prevention instructions for seniors. Howe et al.'s studies in 2007 introduced interventions that utilized multiple exercises for the greatest influence on balance (Howe, Rochester, Jackson, Banks, & Blair, 2007). Nonetheless seniors are still experiencing falls. Seniors are found to experience lower levels of self-efficacy and outcome expectation (Bandura, 2005; McAuley et al., 2009) amongst all age groups, specifically in physical activity (Grove & Spier, 1999; Centers for Disease Control and Prevention, 2003). Fall prevention becomes more difficult to realize without the seniors' compliance towards regular exercise.

In regards to the absence of enthusiasm and self-efficacy among seniors, Dishman's study recognizes three major barriers for senior's physical activity, lack of knowledge of the benefits of exercise, limited access to activity programs, and little or no support for participation (Dishman, 1994). In the elderly population, this lack of knowledge and understanding of the relationship between moderate exercise activity and health is an especially relevant barrier. It might be due to the fact that many lived through a time period when exercise was not valued or deemed necessary (Schutzer & Graves, 2004). Even though the level of one's knowledge does not translate into long-term exercise adherence, over time perceived feelings of enjoyment and satisfaction predict higher levels of adherence (Dishman, 1982; King et al., 1988).

It is evident that there is a clear gap between the scientific facts and compliance from the senior demographic. This gap may be an opportunity for instructional graphic design research to contribute to senior adherence to exercise through exploring exercise instruction design elements suitable for younger seniors.

### **Purpose of Study**

The purpose of this design research is to generate recommendations for instructional design elements that can create a motivating, stimulating and rewarding result. These design elements may create engaging and pleasurable exercise instructions that bring delight to older adults. The research investigates criteria for designing affordable and easily available fall prevention exercise instructions for “young” older adults. These design recommendations may contribute to increasing self-motivation and outcome expectation in seniors so that they can develop and maintain an exercise program.

### **Scope of Research**

This research focuses on fall prevention exercise instructions. Due to the fact that older adults have a greater chance in keeping their strength instead of regaining their strength, the scope of this investigation targets older adults in the sixty to seventy age range. In addition, different styles of fall prevention exercises, their accessibility and availability are investigated. It also examines the design of artifacts to facilitate exercises and the possibility of having home-based exercise routines that can be used in a variety of scenarios. Designers may benefit from understanding what contributes to motivating and delightful instructional graphics, at the same time seniors may benefit from the instructions. This study did not assess the effectiveness of the exercises themselves, but only the appeal of the design principles and the likelihood that it will increase motivation for exercises. Also, medical and health care solutions are outside the scope of this study.

## **Research Question**

In order to investigate the benefits of fall prevention exercise and whether design can enhance motivation to do regular exercise for the elderly, the following questions were addressed in this study.

The main research question addressed in the study is:

1. How can exercise instructions be designed to be engaging and visually appealing to motivate seniors to do regular home based exercises specifically for fall prevention?

The four sub-questions are:

1. What kind of exercises are younger seniors currently doing that might provide insights for the design of home-based exercise instructions?

2. What motivates younger seniors to take part in regular physical activity?

3. What are the visual characteristics of exercise instruction artifacts currently used by younger seniors?

4. What style of exercise instructions do younger seniors find engaging?

## **Contribution to Interdisciplinary Design Research**

This research provides three main contributions to the field of interdisciplinary design for aging. First it introduces the need for reminders of physical activity as a daily routine in seniors' everyday life. Even though seniors have motivation to attend group exercise classes, little is found by previous research about daily reminders of fall prevention exercise.

Second, it provides a conceptual model that serves as a framework for understanding the relations between “aging”, “falling”, “physical activity” and “visual instructions”. This study has established that certain features in designed exercise instructions may create motivation among seniors to do regular physical activity. Taking part in regular fall prevention exercise is known to be one of the factors in reducing the risk of future falls.

Third, it yields recommendations for the design of exercise instructions geared towards the senior demographic. These recommendations include aspects that were not discussed in previous research. The benefit of having exercise instructions that can be done while doing other daily task was introduced in this study. It was established that multi-tasking while doing exercise could be a motivating factor for seniors to do regular physical activity. Also, designing figurative representations that help seniors relate to and find pleasure from can also be an appealing aspect that creates motivation to do regular exercise.

### **Thesis Structure**

This thesis consists of six chapters. The second chapter is a literature review, which examines the existing literature that surrounds the topic of fall prevention and exercise for seniors. This chapter is divided into sections. The first section discusses the relationship between independence and senior falls, including the major barrier to senior independence, the importance of stair falls, the cause of stair falls, and the need for seniors to regain their physical strength. The following section on fall prevention and exercise for older adults discusses the importance of regular exercise in fall prevention

and the current situation of seniors in relation to physical activity. The last section on Instructional design, explores the design of engaging and pleasurable exercise instructions and instructional design elements for seniors.

The third chapter explains the research methodology used in this thesis. It discusses the setting in which the study took place, the population from which sample participants were drawn, the materials and measurement instruments that were used to conduct the study, and the procedures followed for collecting and analyzing the data. A qualitative exploratory method was used, allowing for an extensive analysis of the research problem. Six data gathering methods were utilized in this study, in order to collect information from a variety of perspectives: observations, expert and user interviews, diary keeping, artifact evaluation and online survey, prototype design and evaluation.

The fourth chapter provides the study results and outcomes, presenting the qualitative findings from the empirical investigation and the data analysis. Data collected from the behavioural observations, interviews, diary keeping, artifact survey and prototype evaluation, are organized and the results are then synthesized in relation to the research questions.

The results are interpreted and discussed in chapter five. This chapter is dedicated to understanding the role that instructional design plays in increasing motivation and engagement among the senior demographic. The specific elements that create motivation are discussed along with the researcher's insights. This chapter reviews the research questions in relation to the findings, proposing design recommendations for creating

engaging and pleasurable exercise instructions for seniors. Also, a discussion acknowledging the limitations of this study is included in this chapter.

The conclusion of this study is introduced in chapter six. This is where the three key findings from the research are summarized and the contributions to the field of design are discussed. This chapter also includes suggestions for future research initiatives.

## CHAPTER 2—LITERATURE REVIEW

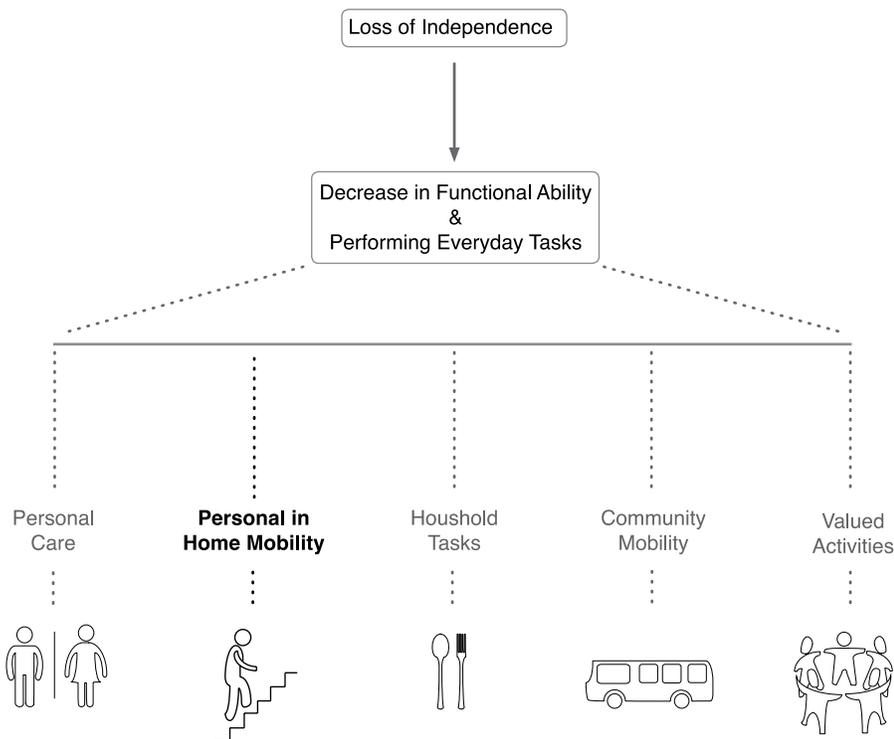
The following sections cover several areas that lead the researcher to the study questions. Based on the research framework, the knowledge gathered from diverse disciplines are summarized under three leading topics: The first section, *Independence & Falls For Older Adults* will address studies related to the elderly population and the need for this demographic to stay independent as long as possible. This section addresses one of the reasons older people have trouble keeping their independence, which is stair falls. Section two, *Fall Prevention & Exercise for Older Adults*, addresses exercise as a possible preventative measure to reduce falls. Finally, the third section, *Instructional Design Assessment & Factors*, addresses research related to design instructions and the need for exercise instruction that brings motivation back to the senior demographic.

### Section I: Independence & Falls for Older Adults

#### Independence & Elderly

A major barrier in maintaining independence among seniors is decrease in functional ability and performing everyday tasks (Chen, 2010). Decreased independence can potentially motivate a variety of behavioural changes, which may adversely affect future health, mobility and activity (Hwu et al. 2001). Gignac & Cott's research divides the activities that can be influenced negatively by decreased independence into different categories (see figure 1): household tasks, community mobility, valued activities, personal care and personal in-home mobility. Household tasks include meal preparation,

house cleaning, and other Instrumental Activities of Daily Living (IADL). Community activities include, getting out of the house on one's own, using transportation such as buses and trains, and getting around one's community. Valued activities include, leisure activities, hobbies, socializing with others, and entertaining at home (Gignac & Cott, 1998). Personal care includes, eating, bathing, dressing, and toileting. Personal in-home mobility includes, walking in one's home, standing, and climbing stairs. Research has proven that the ability to navigate and climb stairs could dramatically improve the quality of elderly life style and overall independence (Nadeau et al., 2003). Gaining independence at the in-home mobility level can have a positive effect on all other levels of independence.



*Figure 1. Activities influenced negatively by decreased independence*

Due to the aging of the baby boomer population in Canada, keeping seniors independence is becoming an important need. During the twentieth century the aging population increased dramatically due to a drop in fertility and the steadily increasing life expectancy. Additionally, the aging of the post World War II baby boom contributed to this pattern. As a result, during the last twenty-five years, the median age of the Canadian population has gradually increased from 27.2 to 38.8 years (Statistics Canada, 2008). Furthermore, the old age “dependency ratio” which refers to the “ratio of dependents per 100 working adults who need care, is expected to change. Dependents are considered to be people younger than 15 or older than 64 (Index mundi, 2013). This change will come to the point that the proportion of elderly could double that of children toward the middle of the twenty-first century, creating an impossible burden on the younger work force (Fougere & Merette, 1999). The consequences associated with aging and increasing life expectancy could include institutionalization in a nursing home, as well as decreasing independence in mobility and daily self-care routines (Sterling, 2001).

As our population continues to age, the quality of life created by functional independence, should become an increasingly important outcome for both design researchers and health care providers. Quality of life is defined as the subjective experiences and perceptions relating to one's overall well being. It includes aspects of the physical, psychological, social, economic, and political environment (Revicki et al., 2000). Functional independence is defined as the capacity of a person to take care of one's own activities of daily life without the help of another person (Revicki et al., 2000).

One of the major problems associated with aging that reduces quality of life and functional independence, is the risk of falls, especially stair falls. The main impact falls have on senior independence is the fear of falling (Walker, Howland, 1991; Lachman et al. 1998; Yardley, Smith, 2002). Since, fear of falling is an obstacle that can limit mobility in the elderly population by reducing motivation toward physical activity, and eventually decrease independence (Howland et al. 1993; Fletcher & Hirdes, 2004). Reduced levels of motivation toward physical activity put seniors at a higher risk for falls.

In summary, the life expectancy of the Canadian society is increasing. The major issue associated with aging and increasing life expectancy is decreasing independence, which leads to reduced levels of physical independence and risk of stair falls. Loss of physical independence is believed to have important consequences on several levels, including: (1) on an individual level in terms of psychological well-being and quality of life; (2) on an economic level in terms of health care and out of pocket expenditures; and (3) on a social level in terms of social burden and dependency. If seniors maintain strength at the individual level, they will be able to better function on all other levels and have more independence. For that reason, the focus of this study will be on the individual level and personal in-home mobility, specifically an instructional tool for fall prevention. While it is becoming clear that there is a need for seniors to stay independent, there are some barriers that make it difficult for them.

### **Falls, major barrier for senior physical independence**

Decrease in physical activity and exercise can lead to muscle deterioration or weakness and ultimately reduces health and physical functioning (Baker & Harvey, 1985;

Tinetti, 1995; Christina, Suzuki et al. 2002; Cavanagh, 2002; Li et al. 2003; DGP 2004; Chamberlin et al., 2005; Scheffer et al 2008). Reduced levels of physical functioning in seniors can lead to the risk of stair falls (Bergland et al. 2003).

Also, studies have reported that aging is associated with decreased stride length and speed, increased stride width and double support time (Hausdorff et al., 1997; Chamberlin et al., 2005). In addition, the pressure on the knee joints is approximately three times greater during stair descent than during level walking (Cavangah et al., 1997; Reeves et al., 2008). This implies that seniors are not able to effectively reduce their body sway during the stair-to-floor transition, causing a fall (Lee, Chou, 2007). That is why, stair navigation, particularly stair descent due to poor balance, reduced grip strength and neurological gait abnormalities, is an extremely challenging and dangerous locomotive task for elderly (Lee, Chou, 2007; Verghese et al., 2008). This challenging task forces seniors to have more cautious behaviour during stair descent than during stair ascent (Christina, Cavanagh, 2002; Hamel, Nadeau et al., 2003; Cavanagh, 2004; Barak et al., 2006). This cautious behaviour reduces seniors' quality of life and prevents them from living independently in their own home. That is why stair efficacy and functional ability are closely linked, forcing subjects with low functional abilities to feel less secure on stairs (Hamel, Cavanagh, 2004). Stair-efficacy relates to how confident a person is that he or she can walk up or down stairs (Hamel, Cavanagh, 2004). Being able to navigate stairs could dramatically improve senior's life quality and ability to stay independent (Nadeau et al., 2003).

Currently, 30% of seniors who are still able to live independently experience a fall each year. Even though most falls don't cause an injury, 25% result in hospital

admissions (Vu, Weintraub, & Rubenstein, 2004). Other than the pain that falls can create for individuals, they also create a financial burden on the health care system and out of pocket expenditures (Englander, 1996). The economic impact of falls in older persons is a matter of increasing concern to public health practitioners and planners as the population age over 65 is growing (Campbell et al. 1981; Hausdorff et al. 2001; Scuffham, 2003; Pijnappels et al. 2008; Sterling, 2001; CDC, 2008; Hektoen et al. 2009; Leitner et al. 2011).

More important than the economic impact created by stair falls are the psychological issues (Campbell et al. 1981; Hausdorff et al. 2001; Scuffham, 2003; Pijnappels et al. 2008; Sterling, 2001; CDC, 2008; Hektoen et al. 2009; Leitner et al. 2011). The chance of seniors remaining independent in their homes is decreasing due to psychological factors such as fear of falling, living independently, being left alone and anxiety (Walker, Howland, 1991; Lachman et al. 1998; Yardley, Smith, 2002). Fear of falling is closely connected to experiencing a fall, since each one is a risk factor for the other (Fletcher & Hirdes, 2004; Scheffer et al. 2008). Most elderly who experience a fall develop a fear of falling that may lead to restricted activity, a decline in social interactions, diminishing the sense of well-being and an increased risk of falling (Howland et al. 1993; Fletcher & Hirdes, 2004). Fear of falling is an obstacle that can limit mobility in the elderly population by reducing motivation toward physical activity.

Stair climbing requires raising the body while taking the next step, a key task that is very demanding for the lower limb muscles and the hip that controls the pelvis. The extensor muscles of the lower limb, particularly the knee extension that needs double the power in comparison to level walking perform this crucial task (Nadeau et al., 2003).

Muscles of elderly persons are trainable and after a period of immobilization attempts should be made to stimulate physical activity (Grimby, 1986). Physical activity will help seniors to regain their strength to climb stairs, eventually perform their daily tasks and regain their independence.

In summary, functional abilities such as balance and controlling body weight are important in stair navigation. Areas that play an important role in enabling seniors to navigate stairs are knee joints, balance and muscles. Seniors are able to regain their muscle strength and balance, since these areas of the body are trainable. Training seniors to improve their muscle strength and balance should be the major focus of exercise-based interventions aimed at improving the safety of stair-efficacy in old age.

### **Section I Summary**

The major issue created by aging is decreased independence, which leads to reduced levels of physical independence and risk of stair falls. The most important consequence of decreased physical independence is on an individual level, in terms of psychological well-being and quality of life. If seniors gain strength they will be able to better function in all other levels of independence. For that reason, the focus of this research is on fall prevention for individuals. Areas that play an important role in enabling seniors to navigate stairs are knee joints, balance and muscles. Seniors are able to regain their muscle strength and balance with physical activity, since these areas of the body are trainable. Interventions that introduce fall prevention exercise to seniors become an important factor in preventing future falls.

## Section II: Fall Prevention & Exercise For Older Adults

### Exercise

It has been established that by participating in a tolerated resistance exercise intervention program that is home-based (Campbell et al., 1997), there can be a significant reduction in the risk of falling and number of falls among elderly persons (Tinetti et al., 1994; Ettinger et al., 1997; Jensen et al., 2002; Barnett et al., 2003; Steultjens et al., 2004; Kanemaru et al., 2010). For example, a rhythmic stepping exercise (RSE) has a stronger effect for fall prevention than a non-rhythmic stepping exercise (NRSE) to decrease fall risk among elderly individuals (Dite & Temple, 2002; Melzer et al. 2007; Sturnieks et al. 2008; Yamada & Ichihashi, 2010). Rhythmic stepping exercise (RSE) requires the use of multiple domains, such as reaction, short-term memory, and stepping to multi-directions, that when impaired, have been shown to increase fall risk among elderly individuals (Yamada & Ichihashi, 2010). Also, Howe et al.'s studies in 2007 show that interventions that implicated gait, balance, muscle strengthening, and those which utilized multiple exercises, appeared to have the greatest influence on balance (Howe, Rochester, Jackson, Banks, & Blair, 2007). An exercise intervention not only reduces the number of risk factors and decreases the incidence of falls, but also increases senior's confidence in performing daily activities. This confidence is an important determinant of daily functioning and living independently for seniors (Tinetti et al., 1994; Haada et al., 1995; Hamel, Cavanagh, 2004; Chen, 2008). Fall prevention exercise will increase senior muscle mass, strength, balance, and stair-negotiating

abilities, while also lowering the risk of falling (Grimby, 1986; Tinetti et al., 1994; Campbell et al., 1997; Ettinger et al., 1997; Barnett et al., 2003; LaStayo et al., 2003).

In summary, research affirms that a rhythmic resistance exercise program that is geared toward fall prevention can be a preventative measure in reducing the risk of falling. Fall prevention exercise can have a positive effect on seniors' confidence helping them gain independence in daily functioning. In order to implement fall prevention exercise programs, it is important to consider the target demographic characteristics and behaviour in regards to physical activity.

**Senior demographic & physical activity.** Most articles about elderly exercise programs are focused on special populations such as individuals with heart disease, arthritis (Au-Yeung et al. 2009; Hackney & Earhart, 2008) and individuals who have experienced falls or are at high risk of falls (Wong, 2004). There is minimal research focusing on younger adults (60-70) who have a greater chance of keeping their strength instead of regaining their strength. Individuals between the ages of 60-70 are considered to be younger adults and individuals over 70 are considered to be older adults. Younger and well-functioning older people might actually be better candidates for benefiting from early preventative interventions, specifically targeting mobility (Rochat et al., 2010). It would be more difficult to target elderly for an exercise intervention since they deny falling and consider it as a reminder of increasing frailty (Battiato, & Owens, 2012). There is a stronger chance of preventing falls when targeting younger adults, since they are already looking for health options and do not necessarily associate fall prevention

exercise with frailty. In order to create fall prevention exercises for older adults, it is necessary to gain knowledge about seniors' general attitude and behaviour of towards physical activity.

Although exercise has been shown to improve a person's functioning and decrease health care costs, two third of individuals over the age of 65 do not exercise regularly (Grove & Spier, 1999). Regardless of the benefits of exercise, older adults experience the lowest levels of physical activity of all age groups (Centers for Disease Control and Prevention, 2003). Among those engaged in physical activity, adherence rates reveal only 30% of older men and 15% of older women actually participate in regular sustained activity (Centers for Disease Control and Prevention, 2003). Lack of encouragement, motivation and engagement towards physical activity reduces senior's physical strength, making them more vulnerable to a fall.

There have been many exercise interventions with the goal of motivating seniors, such as Hickey et al's research in 1992; they suggested that exercising in a group could enhance mental stimulation and life satisfaction (Hickey et al., 1992). Also, Pfister-Mingue's study suggested incorporating a supportive significant other or social network into the exercise regime in order to increase compliance (Pfister-Mingue, 1993). Varied interventions geared toward enhancing exercise participation have consistently revealed limited evidence for long-term effectiveness in this age group. It is evident that these interventions might have been partially successful, however lack of enthusiasm and engagement is still present amongst the seniors. Thus, Health professionals working with young seniors are still challenged to determine what strategies will entice individuals to comply with an exercise program.

There seems to be a gap between the scientific facts and seniors' compliance with physical activity. This gap seems to be a perfect place for different disciplines, such as designers to step in and encourage seniors to adhere to physical activity. Fall prevention becomes more difficult to achieve if seniors will not comply with exercising. .

Certain health behaviours like adherence towards physical activity and exercise can be influenced by personal and environmental variables (Stokols, 1996; King et al., 2002). An individual's self-efficacy beliefs (belief in one's ability to perform a specific behaviour in order to attain a desired result) and outcome expectations strongly correlate with exercise participation, the lack of either one can lead to not having enough motivation towards recommended regular exercise (Bandura, 2005; McAuley et al., 2009; McAuley, Lox, Rudolph, & Travis, 1994; McAuley et al., 2007). Older adults' self-efficacy beliefs are modifiable and can be influenced by assistance in developing achievable outcome goals (Bandura, 2005; Resnick, 2001a, 2001b, 2002; Seefeldt, Malina, & Clark, 2002). The potential and complementary benefits of increasing senior's self-efficacy appear to be great enough to justify widespread efforts at the community and individual level (Elward & Larson, 1992). Having access to available exercise routines, which create engagement among seniors, may be an important factor in influencing senior's self-efficacy and motivation.

In summary, there is a stronger chance to prevent falls and motivate younger seniors in the sixty to seventy age group to follow-up with physical activity. Even though there are various interventions encouraging seniors to take part in fall prevention exercise programs, lack of compliance and motivation toward physical activity is found amongst this demographic. The gap between the scientific facts, compliance, and motivation

towards physical activity from the senior demographic has been identified in the literature. There seems to be a need for an available exercise routine that can create motivation among seniors, by influencing their self-efficacy.

**Motivating & available exercise.** As stated by Stokols and King, certain health behaviours such as adherence towards physical activity can be influenced by personal and environmental variables (Stokols, 1996; King et al., 2002). These variables include the emotional reactions one receives by using a product and how he or she responds to that emotion. As discussed by Norman, “one of the ways by which emotions work is through neurochemicals that bathe particular brain centers and modify perception, decision making, and behaviour. “These neurochemicals change the parameters of thought” (Norman, 2004). He also points out that aesthetically pleasing objects enable the user to work and react better (Norman, 2004). Norman believes products and systems that make you feel good are easier to deal with and produce more harmonious results. Accordingly, exercise instructions that are aesthetically appealing have the ability to create engagement in seniors. This engagement creates a positive change in seniors’ behaviour, encouraging and motivating them to follow-up with regular exercise.

In addition, while recent recommendations suggest that older adults should develop exercise plans and goals with their physician (Cress et al., 2005; Nelson et al., 2007), little is known about the availability of experts to create these plans and instructions. Cost and membership criteria are the most frequent barrier to exercise listed by adults (Shih et al. 2006; Rimmer et al., 2008; Schoenberg, 2008). Having knowledge and access to fitness instructions that can help regain the loss of strength and balance becomes a major factor, since it can enable seniors to regain their physical strength by

practicing fitness regularly. The option of an available home-based exercise program may be an alternative to avoid membership costs. Home-based exercises do not need to be costly or involve sophisticated rehabilitation equipment in order to be effective. The relative effectiveness of inexpensive, low technology exercise has led to a call for the development of more affordable, low-tech programs (Dickstein, 2008).

In summary, aesthetically pleasing products have the ability to create positive emotions that can influence the users behaviour to engage better. Also, it seems that there is a need for a more affordable and accessible home-based exercise program that targets fall prevention for elderly. The design of engaging and accessible exercise instructions that focus on improving fitness, which in turn may contribute to preventing falls becomes the preliminary focus for this research.

## **Section II Summary**

A rhythmic resistance exercise program can be a preventative measure in reducing the risk of falling. Fall prevention exercise can increase seniors' confidence and independence. There is a stronger chance to prevent falls and motivate younger seniors in the sixty to seventy age group to follow-up with physical activity. Lack of compliance and motivation toward physical activity is found amongst the seniors. Aesthetically pleasing products have the ability to create positive emotions that can influence the users behaviour to engage in exercise. The design of engaging and accessible exercise instructions that focus on improving fitness, which in turn may contribute to preventing falls becomes the preliminary focus for this research.

### **Section III: Instructional Design**

It has been established that visually engaging instructions can motivate the senior demographic to do exercise. One of the aspects found in the design literature that can increase engagement among users is the concept of designing for pleasure and positive emotion. Design that induces pleasure and positive emotion has been proven to enable people to work better and produce better results (Norman, 2004). This concept is addressed in the following sub-sections:

#### **Pleasure & Aesthetically Engaging Design**

Desmet & Hekkert describe pleasure as a product benefit that exceeds proper functioning. In other words, pleasure is an emotional benefit that supplements product functionality (Desmet & Hekkert, 2000) and conveys the message of the product. In her presentation at Ottawa, Ontario UX Camp (October, 13, 2012), “Deconstructing Delight: Pleasure, Flow, and Meaning”, Dana Chisnell discusses the need to move from just “usable” design to ‘delightful’ design (Chisnell, 2012). Chisnell refers to “usable” design as a design with no consideration of “humanity”. On the other hand, she describes the elements of delightful design, as a design experience that drives engagement, flow and pleasure. A delightful experience is created by a design that has a clear message, and that takes into consideration what the user needs. As an example, Chisnell uses a forecast webpage that not only answers the needed questions in a clear manner, but in a delightful and fun way (Chisnell, 2013). This forecast only answers the important questions one needs to know when heading outdoors. Answering necessary questions such as, what do I wear when I go out, instead of overwhelming the user in a data saturated way.

In addition, delight can be achieved by using subtle language cues and contextual responsiveness. Contextual responsiveness is achieved by anticipating the users needs in a subtle approach. For instance, the website ‘Tripit’ anticipates the need of the user by including a sharing icon; the users can share their trip itinerary with other people. This demonstrates ‘Tripit’ responding to the users needs, by being thoughtful and aware of the users other relationships. ‘Tripit’, is taking a step further from just the relationship of the user and application, but responding to the connection of the user with family and friends (Chisnell, 2013). It also gives little treats by keeping track of your previous trips in a map. This all introduces pleasure, delight and flow to the user, creating an experience that would allow the user to re-visit that webpage or product. The user experiences a flowing experience, there is no gap between “what the person needs to know to use the tool” and “what it takes to actually use the tool”. A pleasurable design that would increase user abilities to accomplish a new routine and to gain a larger perspective in using the instructions (Chisnell, 2012) may help create motivation among the senior demographic.

During this process, the designer attempts to persuade the audience to gain information demonstrated or suggested through the two-dimensional object. The purpose of this persuasion is to encourage the audience to take some action and to educate them (persuade them to accept the information); this includes making a point that the information is fact and true (Tyler, 1992). As the goal of all visual communication of instructions is to influence some belief about the background of each design piece, audience and demographic considerations are integral components of the process of visual communication (Buchanan, 1989). In order to persuade users and to create pleasure, a designer has to know how the audience interprets the product and design.

Creusen discusses that users interpret messages from visual information by looking at a product in two ways: 1) by using analytic information processing (by regarding specific characteristics or product parts), or by 2) using holistic information processing (by regarding the overall impression) (Creusen 1998). Studies that have investigated the information consumers infer from looking at a product, have found that many consumers derive pleasure from the form or appearance of a product (Creusen & Snelders, 2002). Furthermore, it was found that a large part of these judgments was made with the use of holistic information processing (Creusen 1998), and that they were based on abstract attributes (Snelders and Schoormans 2000).

Jordan utilizes a framework referred to as ‘the four pleasures’, which describes four different kinds of pleasure: physical, social, psychological and ideological (Jordan, 2000). These categories are defined as, physio-pleasure: gained from the body and the five sensory properties; social pleasure: derived from relationships with others; psycho-pleasure: gained when a product helps the user to establish a task; ideo-pleasure: gained from the users values (Jordan, 2000). According to the categories of pleasure in product use, fall prevention exercise instructions are aiming to motivate seniors’ physio-pleasure, psycho-pleasure and ideo-pleasure (Jordan, 2000). Based on his studies, Jordan states that lack of usability, lack of reliability and poor aesthetics have been the main factors associated with ‘displeasurable’ products (Jordan, 1996). When users experience “displeasurable” emotions and fail to reach psycho-pleasure, they will not achieve the task the product is trying to communicate.

In addition, Norman describes the connections between the affective and cognitive systems, in order to create an understanding of how design can affect emotions

and pleasure (Norman, 2004). The affective system, which includes emotion, processes information to allow individuals to make reactionary judgments about the visual aesthetics of an object. Sometimes emotions and affective conditions are encouraged by cognition, while other times, cognition is influenced by affective state. The affective and cognitive systems are both critical for decision-making. Norman affirms that emotions are an inseparable part of cognition, and that emotions change the way we experience, judge, and behave. Emotions change our perceptions of the world and our decision-making process (Norman, 2004). Therefore, if the visual properties of objects can change an individual's emotional state and how their cognitive system functions, the connection between visual properties and operation becomes clear. This confirms that the appearance of an object can create motivation and pleasure, creating the "want" in using the object. For that reason, creating an engaging design that brings delight and flow to seniors, to persuade them to do daily exercise can be a major element to create motivation.

In summary, pleasure in product design is an emotional benefit that helps to convey the message of the product to the user. The element of delight and delightful design is achieved when the user experiences engagement, flow and pleasure. A pleasurable design can increase the user's ability to accomplish a new routine and to follow instructions by using the power of persuasion. Many users derive pleasure from the appearance of a product. Fall prevention exercise instructions are aiming to gain the physio-pleasure, psycho-pleasure and iseo-pleasure of elderly. When users experience "displeasurable" emotions and fail to reach psycho-pleasure, they will not be motivated to achieve the task the product is trying to communicate. Therefore, pleasure and

emotions can change our perceptions of the world and our decision-making process. Consecutively, to develop the enthusiasm and encouragement among seniors to follow exercise instructions, designers can incorporate visual designs that bring pleasure, delight and flow.

To create pleasurable and engaging exercise instructions for seniors, designers must become familiar with the manner in which this demographic perceives visual instructions. Also, having knowledge of the proper graphic elements for the senior demographic becomes essential.

**Design of visual instructions for seniors.** There are numerous factors influencing the ability of older adults to learn new skills. When instructions are not well designed, they can create additional challenges. Older adults experience changes in many cognitive abilities. The elderly experience problems in reading due to loss of central and peripheral field, blurred vision and significant difficulties in low light environments (Nini, 2006; Klein, 1991). Their working memory, sensory, perceptual speed and attention become less acute; this has implications for the design of instructional material (Nini, 2006; Czaja and Sharit, 2012). Due to these difficulties, it is necessary to consider different factors when selecting typeface, composition and figure representation for older adults.

**Type Style & Size.** Typeface, size and style are a significant factor in communication design, especially in designing for older adults who experience eyesight and vision barriers (Strickler & Neafsey, 2000). Based on Strickler & Neafsey's study, bold type is easier for seniors to read, and the type size and position in space become the principle means for text differentiation (Strickler & Neafsey, 2000). Older adults need a

larger type size than younger readers to read text comfortably (Morrell, & Echt, 1997). Typefaces such as Futura, Helvetica and Frutiger with larger x-height and wide proportions are good examples for improving readability under low vision conditions (Kline & Lynk, 1993; Nini, 2006). Other than the actual typeface, the composition and placement of the type becomes important for information legibility.

**Composition and contrast.** It is easier for seniors to comprehend the text, when the text layout is organized into blocks for rapid reading, with paragraphs of five lines or less (Strickler & Neafsey, 2000). Also, the contrast between text and background is important since the ability to perceive light/dark and color contrast diminishes with age (Kline & Schieber, 1985). Having a smooth transition between gray to white or different shades of color is helpful in comprehending image and text (Strickler & Neafsey, 2000). Strickler & Neafsey also say that for a design to be appealing and legible for the older adults designers should use 18-point bold typeface or larger and strong contrast between the type and background values.

**Figure Representation.** According to Strickler & Neafsey, little has been written about the older adult's aesthetic preferences for visual presentation of information. In their study, when evaluating the prototypes of medical illustrations, the seniors noted that the figure looked old and they did not find that appealing (Strickler & Neafsey, 2000). Overall, the absence of facial features, oldness, baldness of the figure was found to be impersonal and not appealing. In addition, research in psychology and marketing indicates that the elderly have a cognitive preference for cartoon and simple picture based information, rather than just text-based information, since it improves recall, comprehension, and adherence (Mansoor, Dowse, 2003; Dowse, Ehlers, 2005; Katz,

2006; Houts et al. 2006). Also, the ‘use of bold and descriptive outlines in illustrations and simplified background’ make the information more legible for the senior demographic (Strickler & Neafsey, 2000).

In summary, aging individuals experience issues with reading, therefore visual elements should cater to the aging eye. Bold and larger typefaces such as Futura, Helvetica and Furtiger are easier to read. Texts that are in blocks and have fewer lines are much easier to comprehend. Figures that represent frailty are not appealing to seniors; they prefer simple illustrations in the form of cartoons and drawings.

### **Section III Summary**

A pleasurable design can increase the user’s ability to accomplish a new routine and to follow instructions by using the power of persuasion. Pleasure and emotions can change peoples’ perceptions of the world and their decision-making process., Designers can incorporate visual designs that bring pleasure, delight and flow to develop the enthusiasm and encouragement among seniors to follow exercise instructions. Aging individuals experience issues with reading. Bold and larger typefaces in the form of blocks with fewer lines are much easier to comprehend. Figures that represent frailty are not appealing to seniors; they prefer simple illustrations in the form of cartoons and drawings.

### **Literature Review Summary**

The major issue created by aging is decreased independence, which leads to reduced levels of physical independence and risk of stair falls. If seniors gain strength and independence on an individual level (walking in your own home, standing, and

climbing stairs), they will be able to better function in all other levels of daily functioning. Knee joints, balance and muscles play a crucial role in stair navigation; decreased strength in these areas can lead to a stair fall. Seniors are able to regain their muscle strength and balance with physical activity. A rhythmic resistance exercise program can help seniors regain their strength and reduce the risk of falls. Fall prevention exercise can also increase seniors' confidence and independence. There is a stronger chance to motivate younger seniors in the sixty to seventy age groups to follow-up with fall prevention exercise. Seniors demonstrate a lack of compliance and motivation toward physical activity.

A pleasurable design can increase the users ability to accomplish a new routine and to follow instructions by using the power of motivation. Aging individuals experience issues with reading, bold and larger typefaces in the form of blocks with fewer lines are much easier to comprehend. Figures that represent frailty are not appealing to the seniors; they prefer simple illustrations in the form of cartoons and drawings. The design of engaging and accessible exercise instructions that focus on improving fitness, which in turn may contribute to preventing falls, becomes the main focus for this research.

### **Framing The Research**

The analysis of the literature connected with aging population, fall prevention exercise, and instructional design elements intended for seniors, guided the elaboration of questions that could possibly be addressed by the research. The main question the researcher was interested in was how can exercise instructions be designed to be engaging and visually appealing to motivate seniors to do regular home based exercises

specifically for fall prevention? There after, what motivates younger seniors to take part in regular physical activity? And what style of exercise instructions do younger seniors find engaging?

From the literature exploration, it was possible to identify the importance of providing aging adults with affordable exercise to prevent future falls. The literature also indicated the specific requirements needed for designing instructional graphics for fall prevention exercise programs. These factors range from motivating seniors to exercise to prevent falls to suitable design elements for the senior demographic. Design elements that create a pleasurable experience were identified as important factors in generating engagement and positive emotion for following exercise instructions among seniors. Also, specific graphic elements such as, typefaces, visual compositions and the importance of figure representation were identified as factors that can increase comprehension and appeal.

## CHAPTER 3—METHODS

### Introduction

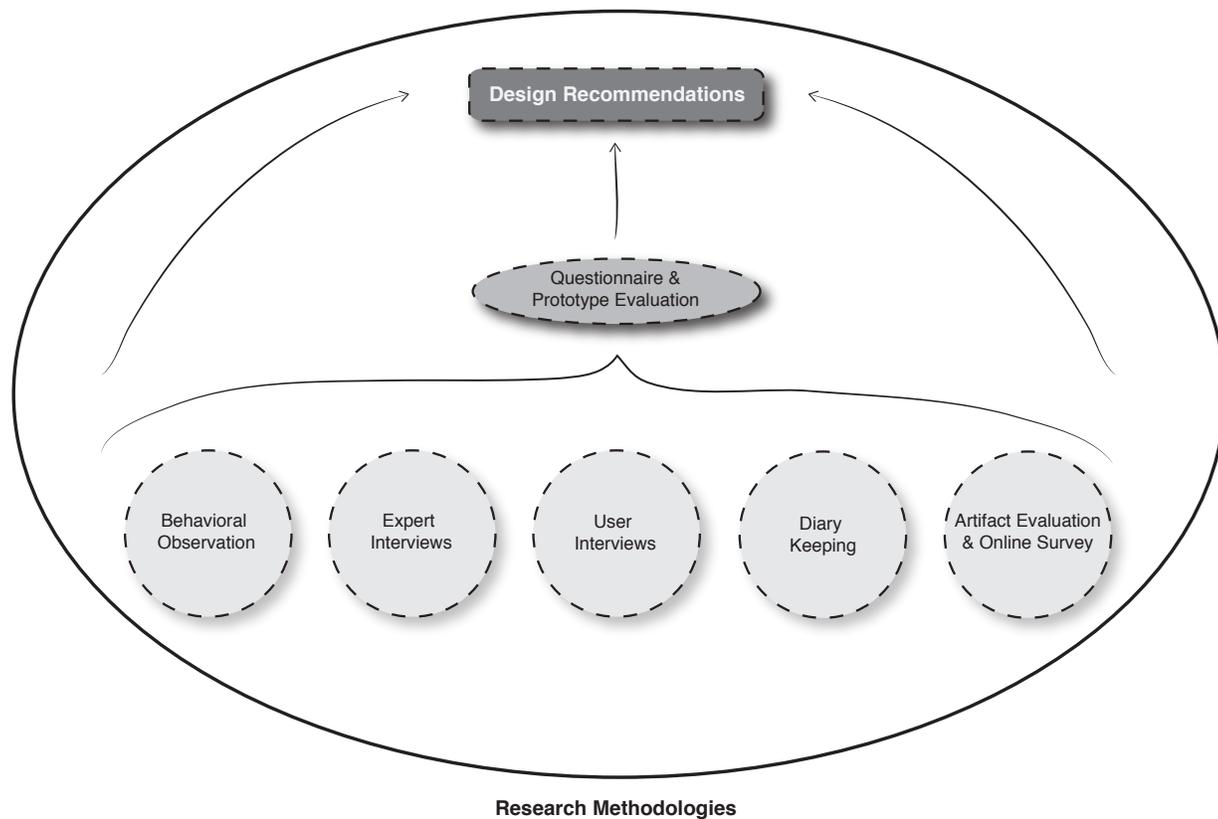
The methodology of this research is primarily qualitative and uses a mixed method approach.

As stated by Creswell “qualitative research is an approach for exploring and understanding the meaning individuals ascribe to a social problem” (Creswell, 2009). Qualitative research allows the researcher to analyze data from particular to general themes (Creswell, 2009). The preliminary research method of this study was qualitative research, since it allowed the researcher to gather information in an inductive manner that would not be possible to obtain using only a quantitative method (Creswell, 2009). The data collection and analysis for this study followed an iterative cycle of induction and deduction, consisting of collection of data and constant comparison between results and new findings in order to guide further data collections. Data is collected until theoretical saturation is reached, in other words until no new or relevant data emerges and relationships between categories are established (Strauss and Corbin, 1998).

Accordingly, the final recommendation of this research is based on findings from six data collection methods: observation, expert & user interviews, diary keeping, artifact evaluation (online survey), prototype design and evaluation (written questionnaire) (see Figure 1). Mixed methods of data collection and analysis were used in order to acquire

both qualitative and quantitative data and to gain a richer range of information from a variety of perspectives.

“Mixed methods research is a research design (or methodology) in which the researcher collects, analyzes, and mixes (integrates or connects) both quantitative and qualitative data in a single study or a multiphase program of inquiry” (Creswell, 2011). In order to research different resources and key informants in a variety of context, and to triangulate the findings from the different methods and sources a mixed method approach was utilized. This approach allowed the researcher to scope the most common findings from the different methods and sources into the final recommendations of the study. In the first stage of this research, qualitative data was collected through observations, interviews, diary keeping and online survey, and the prototype evaluation questionnaire completed the findings and gave the researcher the opportunity to finalize the results. A mixed method was used in the evaluation questionnaire; the researcher collected both forms of data at the same time and combined the information in the analysis of the overall results (see Figure 2).



*Figure 2. Methods used within this study*

In order to answer the main research question, *‘How can exercise instructions be designed to be engaging and visually appealing to motivate seniors to do regular home based exercises specifically for fall prevention?’* the researcher had to address the first sub-question, *‘what kind of exercises are younger seniors currently doing that might provide insights for the design of home-based exercise instructions?’* Observing senior fitness classes found insights related to this question. This observation helped the researcher check for non-verbal expression of feelings, to grasp how participants communicate with each other, and check for how much time is spent on various

activities. The analysis of the collected data from the observations lead the researcher to the next research question, *‘what motivates younger seniors to take part in regular physical activity?’* Utilizing expert and user interviews along with diary keeping provided more data related to this question. The semi-structured expert & user interviews revealed in-depth information pertaining to participants’ experiences and viewpoints of physical activity. The diary keeping method allowed the researcher to gain information about quality of life, social well-being and patterns of leisure and physical activity of the senior community. Accordingly, the analysis of the collected data led to the next question, *‘what are the visual characteristics of exercise instruction artifacts currently used by younger seniors?’* Answering this question led to artifact evaluation phase of the study. This phase provided information about current exercise artifacts and allowed the researcher to gain knowledge about seniors’ visual and aesthetic preferences. The collected data led to the last research question *‘what style of exercise instructions do younger seniors find engaging?’* which was answered by utilizing prototype design and evaluation. The methods are described in chronological order and in more detail in the following sections.

## **Behavioural Observations**

### **Setting**

The observations took place in two different fitness centers in Ottawa, Ontario. The first two sessions took place on the Carleton University campus. The exercise room was on the second floor of the main gym building, a spacious room surrounded with mirrors and bright windows. The other four observations took place at the Good Companion’s Senior Centre in the large room located on the main level of the centre. The researcher had the opportunity to observe the class and individuals from different angles

of the rooms.

### **Sample/ Participants**

The researcher observed a homogenous sampling of older adults; the sampling was based on similar age group. Four of the classes that were observed included an average of twenty individuals and the other two classes included an average of seven participants. The participants in this section of the study were from diverse ethnic backgrounds. They were mainly retired individuals in the age range of 60-70, and on average there were more female participants compared to males. The overall ratio of females to males in 6 classes were (Table 1): session 1: even amount; session 2: 6 females to 5 males; session 3: 5 females to 2 males; session 4: 6 females to 1 male; session 5: 4 females to 1 male and session 6: 5 females to 2 males. There seems to be more females than males attending the fitness classes. The participants were recruited through targeted e-mails, which were sent to the centers for permission to observe the class, while the instructor informed participants.

	Session#1	Session#2	Session#3	Session#4	Session#5	Session#6
Female	5	6	5	6	4	5
Male	5	5	2	1	1	2

*Table 1. Class Observation-Gender Ratio*

### **Data Collection/ Procedure**

The researcher took field notes and rough sketches of six exercise classes, two hours each for two of the sessions, an hour and a half for the other four sessions, totaling ten hours of observations. The rough sketches included exercise moves which were repeated across all classes, they were used mainly as reference tools for the researcher. The instructor introduced the researcher to the participants and allowed the researcher to take notes and observe the class from different locations in the room. In order to find answers to the research question “*what kind of exercises are younger seniors currently doing that might provide insights for the design of home-based exercise instructions?*” the researcher took note of the following key points. The key points the researcher was expecting to observe included, specific exercise moves, repetition of each move, responses to instructions given by the instructor, difficulty/ease in following instructions, tone of instructor, and seniors’ interactions with one-another. The researcher would ask the instructor to elaborate certain terms and exercise moves in between the seniors’ water breaks, to better understand the moves and behaviours. Also, at times the researcher was asked to participate in the fitness class and to do some moves to better understand the feel of the class.

### **Data Analysis**

The researcher conducted a basic review of the notes and sketches to get a general sense of the content. Then the researcher conducted a more thorough analysis of the information by coding and categorizing the collected data into different themes and patterns into an affinity diagram. All the typed notes were placed into a Word and Excel spread sheet. Each similar unit and theme was color coded and eventually named.

Although the sketches did not provide much depth in the data analysis process, they were still used to provide visual support to the observation notes. After the researcher did the coding, an external rater coded two observation sessions to assess coding reliability; the results of the similar coding and match were 85% (see Appendix A. External rater Table–Fitness Class Observation).

### **Expert Interviews**

The researcher conducted semi-structured interviews in order to answer the second sub-question: *what motivates younger seniors to take part in regular physical activity?* and to gain knowledge and insight about specific exercises needed for fall prevention., The interviewees included, five fitness instructors and one health care professional with experience in physical activity for seniors, especially in fall prevention. The interviews were done in person. The instructor's point of view of the seniors' behaviour during fitness class helped the researcher gain greater insight on what motivates the seniors to do regular physical activity. Also, the information gained from the interviews was used to understand the knowledge from the literature in regards to different styles of physical activity associated to fall prevention.

### **Setting**

The interviews were conducted at different times according to the interviewee's convenience. Overall, two of the interviews were held in the same room where the participant conducted exercise classes, and the other four were held in a café and office. The participants chose the locations, in order for them to be in a place they preferred. The researcher wanted the interviews to be informal and relaxed, so it was important that the

participants felt comfortable in the given setting. This allowed the participants to share information and experience in a casual way.

### **Sample/ Participants**

The procedure used by the researcher was expert sampling and the participants were recruited through emails using the researcher's personal network. The six interviews included three fitness instructors, two personal trainers and one physiotherapist. They were all females with at least two years of experience in the field of physical fitness.

### **Measurement Instrument**

There were fifteen questions that were based on the key information found in the literature review and based on the duration and direction of the interview. These questions and the interviewing procedures were pilot-tested with a volunteer participant and were reviewed by the researcher's co-advisors and slight changes were made to the questions to improve the structure and ultimately increase reliability of the interview protocol. Consequently, at times some questions were omitted, while others were added ad-hoc during the course of the interview to delve deeper into a particular topic of interest when relevant. Probes were also used to further explain an abstract concept or obtain supplementary information on a certain question.

### **Data Collection/ Procedure**

The interviews were conducted in person upon receiving informed consent (see Appendix B and C for Interview Questions & Consent, Debriefing Form). Each interview began with a brief summary of the scope and purpose of the research study. The researcher requested permission to audio record the interviews, the duration of the

interviews were no longer than 30-40 minutes. A de-briefing form was provided to the participant informing her or him about the scope of the research and possible sources in regards to the study. The data from the interviews were transcribed, coded and sorted into emerging themes.

### **Data Analysis**

Interviews were transcribed, however hesitations and grammatical errors were not included as they were not significant in helping to answer the research questions. Data analysis involved a coding process and affinity diagram to categorize and to label the data into meaningful groups. All analysis was completed using Microsoft Word and Excel sheets. The goal was to draw out major themes or relationships in the hopes of identifying design patterns. The researcher analyzed the transcripts individually before merging the comprehensive results from each. Also, replies to the question asking for current exercise artifacts were collected and used in the next methodology (artifact evaluation). After scanning the transcripts, the researcher looked for common themes and categories. Based on the commonalities, the researcher created a preliminary affinity diagram including eight different categories. The next step involved organizing the themes into patterns that would help in answering the research questions. In order to assess reliability of the coding the researcher asked two external raters to code two samples of the interview results, there was an overall average of 50% matching codes (see Appendix D for the External Raters Table- Expert Interview). Since the data collected from the interviews answered parts of the research question, the researcher decided to move on to the next method using the findings. Therefore, the 50% match between the external rater and the researcher was a sufficient match for this section of the study.

## User Interviews

Based on key themes from the literature review, semi-structured interview questions were developed to ask seniors who had just finished a fitness class. The goal of this interview was to have a stronger understanding of the motivation to do physical activity; since the participants were fresh from finishing an exercise session they had a clear idea of what their motivation was. This method helped the researcher gain greater insight to answer the second research sub-question, *what motivates younger seniors to take part in regular physical activity?* The representative sample was limited to persons between the ages of 60-70 years who have just finished an exercise session.

### Setting

The interviews were conducted right after the participants finished an exercise session. For the convenience of the participants, most of the interviews were held in the same room where the participant had completed an exercise session; others were held in the centre's cafeteria. The participants chose the locations, for their comfort. The researcher wanted the interviews to be informal and relaxed, so the participant would feel at ease in sharing their experience and expanding their reply by telling personal stories.

### Sample/ Participants

The user interviews were a homogeneous sampling based on age and whether they had taken part in a particular fitness class. A total of 14 men (4) and women (10) between the ages of 60 and 70 (Mean age = 68, *SD* 3.5) participated. They were recruited through targeted e-mails sent to the centers for permission and asked on site, due to reasons of feasibility and accessibility.

### **Measurement Instrument**

There were fifteen base questions (see Appendix E for User Interview Questions). The questions addressed key themes from the literature review and then they were pilot-tested with a volunteer participant. The researcher's advisor and co-advisor reviewed the interview protocols. Slight changes were made to the questions to improve the structure and ultimately to increase the reliability of the interview protocol.

### **Data Collection/ Procedure**

A total number of fourteen interviews were conducted in person upon receiving informed consent (see Appendix F for Consent Form). Each interview began with a brief summary of the scope and purpose of the research study and requested permission to audio record the interviews. The duration of the interviews was between 20-30 minutes. Right after the interview the participant was provided with a de-briefing form explaining the scope of the study and sources in regards to the research (see Appendix F for the De-briefing Form). The data from the interviews was transcribed, coded and sorted into emerging themes.

### **Data Analysis**

Interviews were transcribed; the analysis involved a coding process to categorize and to label the data into meaningful groups. The results of the external raters coding match was an overall average of 73% matching codes. (See Appendix G for a sample of the External Raters Coding Form)

## Diary Keeping

### Setting

Since the time line of the Diary Keeping was seven days, this activity was done in the comfort of the participant's home using his/her personal computer. The diary entries were done using penzu.com, this secure website allowed the seniors to log in at anytime to enter their daily activities. The researcher provided a pre-entered table each day of the week to help the seniors better organize their daily entries (Figure 1).

penzu.com/p

46 words

January 10, 2013

January 10, 2013

**Morning**

Type of activity:

Location:

Duration & Time:

Individual/Group:

**Noon**

Type of activity:

Location:

Duration & Time:

Individual/Group:

**After Noon**

Type of activity:

Location:

Duration & Time:

Individual/Group:

**Evening**

Type of activity:

Location:

Duration & Time:

Individual/Group:

**Night**

Type of activity:

Location:

*Figure 3 Diary Keeping Table*

**Sample/ Participants**

A total of 5 men (2) and women (3) between the ages of 60 and 70 (Mean age = 65.2, *SD* 2.9) participated. This included two male university professors and three retired females. It was important that the participants were comfortable with technology and had the knowledge to use a computer. The participants were recruited using recruitment posters placed at senior centers and were also asked in person.

**Data Collection/ Procedure**

After the participants were provided with the consent form, the diary keeping process was explained to them asking them to keep a private diary of their day-to-day activities on the online blog provided to them. The participant needed to log in to the blog to write what they did every day for 1 week. The researcher sent e-mails with the specifications for the online blog and their login information along with an instruction sheet (see Appendix H for a sample of the Instruction Sheet). For the purpose of follow-up, two e-mails were sent during the seven days to make sure the participants were on the right track and if they had any questions or concerns. The researcher's Carleton Connect account was used to manage the emails. All emails and data were downloaded from the mail servers upon receipt and stored in a secure private external hard drive along with the coded data.

**Data Analysis**

The data collected from the diary entries were categorized in terms of common themes and matching relevant information to answer the research question: *What motivates younger seniors to take part in regular physical activity?*

A coding method was used to organize the data into a limited number of themes and issues around day-to-day activities.

### **Artifact Evaluation**

In order to answer the third sub-question, *what are the visual characteristics of exercise instruction artifacts currently used by younger seniors?* and to be able to assess affordable and available exercise instructions, the researcher gathered visual artifacts from different sources. Many of the items were introduced in the expert interviews as a reply to one of the interview questions; other items were gathered from local bookstores and online sites. The exercise instruction artifacts were placed in different categories and named based on their similarities. Overall four groups were created based on color, text, visual style and type of information (see Appendix I for the Artifact Analysis Diagram).

### **Online Survey**

In order to understand the visual preferences of the senior demographic, they were introduced to an online survey on [www.websort.net](http://www.websort.net). This survey allowed them to categorize images from the collected artifacts section of the research. Also, the participants were asked to name each category based on their preference. The individuals were recruited by e-mail and on site.

### **Setting**

Some participants did the online survey individually at their chosen location and time line. Other surveys were done at Billings Bridge Mall located in Ottawa, Ontario using the researcher's computer.

**Sample/ Participants**

The online survey was also based on a homogeneous age sampling, it was important that the participants were in the age group of 60-70. Among the seven individuals who participated, two were male and five female. They were recruited with targeted e-mails and asked on site.

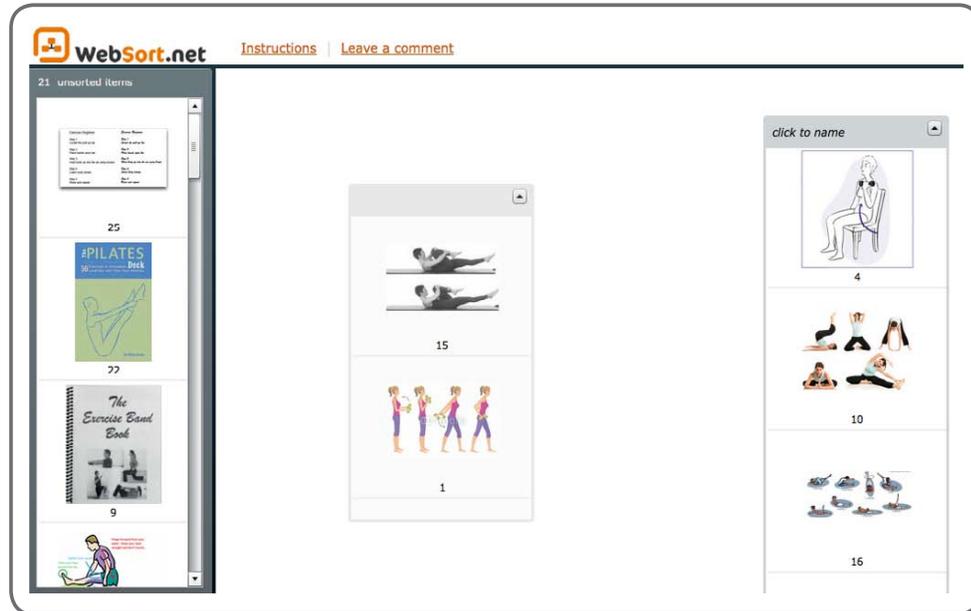
**Measurement Instrument**

Overall, twenty-five images were provided to the participants and they were asked to group them into one to five categories. The images were chosen based on the previous Artifact Evaluation section of the research; the survey process was pilot-tested with a volunteer participant and was reviewed by the researcher's co-advisors.

**Data Collection/ Procedure**

Web Sort allows for items in a list to be grouped by participants according to the similarities that are found between the different items (Figure 2). The groups can be given a title by the participants, indicating the reasoning behind that grouping. The participants were sent instructions (see Appendix J for a sample of the WebSort Instructions Sheet) on how to complete the activity. Participants were able to visit the activity online through a provided link, to begin sorting through the images. The participants were asked to group all the images, located on the side bar, by clicking and dragging them onto the main screen. Once all the images were situated into groups, the participants were able to name their categories in a way that can describe the contents best. The next step was for the participants to rate the categories based on their preference and leave a reason for their choice in the comment section of the site. None of the participants were able to see the names of the categories that were developed by other

participants. In the end there were seven participants in this activity from Ottawa, Ontario.



*Figure 4. WebSort Online Survey*

## Data Analysis

All the visuals that were gathered to develop the first affinity diagram for the artifact evaluation were inserted into the study and sent out to senior participants through Web Sort ([www.websort.net](http://www.websort.net)). The data collected from the online survey was analyzed into a tree graph using the online Websort site. The researcher analyzed two major clusters of the tree graph by categorizing the groups of images based on the given comments and preference rating of the participants. The tree images were categorized into 4 major groups based on the participants' categories and the categories created in the artifact section of the study.

## **Prototype Evaluation**

To evaluate senior's visual preference and to answer the fourth research sub-question, *what style of exercise instructions do younger seniors find engaging?* the prototypes were designed and evaluated. Based on data gathered from the previous methodologies, six pairs of visual prototypes of possible exercise instructions were designed by the researcher. Participants in the 60-70 age group were asked to evaluate the prototypes by answering a short questionnaire.

### **Setting**

For convenience of the participants, three of the evaluation sessions were held in the participant's office; two of the evaluations were held at Ottawa, ON Billings Bridge Mall where the participants were recruited. The participants chose the locations, in order for them to have convenience and comfort.

### **Sample/ Participants**

The evaluation sessions were based on homogeneous sampling, it was important that the participants were in the age group of 60-70. The participants for this part of the study were from various ethnic backgrounds and primarily English speaking. Among the five individuals who participated two were males and three females. They were recruited with targeted e-mails and asked on site. This section of the research had a small sample size, due to the fact that the researcher reached saturation of data. Bowen (2008) refers to data saturation as, "bringing new participants continually into the study until the data set is complete, as indicated by data replication or redundancy". Additionally, Morse et al. (2002) point to the fact that "saturating data ensures replication in categories; replication verifies, and ensures comprehension and completeness". Accordingly, in this method data

saturation was reached, since no new information and theme was being added to the findings, secondly the findings from this sample size confirmed the found common themes from previous study methods.

### **Measurement Instrument**

Overall, there were seven questions including four rating and two open-ended questions based on the key information found in previous methodologies. (See Appendix K for a sample of the evaluation questions). The researcher's co-advisors reviewed these questions and the evaluation procedures. Slight changes were made to the questions to improve their structure to ultimately increase the reliability of the interview protocol.

### **Data Collection/ Procedure**

A total number of five evaluation sessions were conducted in person upon receiving informed consents (see Appendix K for Prototype Evaluation Questionnaire). Each session began with a brief summary of the scope and purpose of the research study. The duration of the evaluation session was between 30-40 minutes. After the participants were provided with the evaluation questionnaire, different pairs of visual exercise instructions that were designed previously by the researcher were provided to the participants. The participants were asked to provide a response after interacting with each pair of prototypes. Right after the session the participants were provided with a debriefing form explaining the scope of the study and sources related to the research. The data from the session was transcribed, coded and sorted into emerging themes (see Appendix L for Prototype Evaluation Coding).

### **Data Analysis**

The data collected from the prototype evaluations were categorized in terms of

common themes and matching relevant information to answer the research question. The affinity diagram coding method was used to organize the data into a limited number of themes with respect to visual elements.

### **Ethical Considerations**

The data collected from all different methods were strictly confidential. All data were coded so the name of the participants was not associated with the responses they provided. The anonymously coded data were stored in a secure private external hard drive for the duration of the next two years and will be used for research and teaching purposes only. The on line diary keeping and survey was in a secure website with anonymous log in names, accessed only by the participant and researcher. This research received ethics clearance by the Carleton University Research Ethics Board on January 2013, and a copy of the ethics clearance is provided in Appendix M.

The data collected through the methods presented in this chapter are revealed in the following section of this thesis report. The discussions generated are provided based on the study of both findings and collected literature.

## CHAPTER 4—FINDINGS

The results of the data gathering process are presented and organized according to the steps taken by the researcher to answer each research question. They were ordered according to the categories, which evolved during the data compilation and analysis. First, the detailed findings from the exercise session observations are presented, followed by the significant findings. The significant findings of each method provide answers to each research question. In the same manner, the results from the expert and user interviews, diary keeping and artifact evaluation (online survey) are presented. Finally, the data collected from the prototype evaluation section of this study are presented.

**Research sub-question one:** *What kind of exercises are younger seniors currently doing that might provide insights for the design of home-based exercise instructions?*

### **Behavioural Observations Findings:**

The findings from the analysis of fitness class observations that address the research question are provided followed by the main findings:

The researcher coded the data collected from the six observed fitness classes and categorized them into six different themes. These six themes included: 1) Gender & Age

2) Exercise Focus 3) Social Aspect 4) Lighting & Space 5) Position 6) Music and 7) Exercise Moves. Table 2 presents the collected data and outcome.

CATEGORIES/CODE	OBSERVATION	COMMENTS	
<b>BEHAVIORAL OBSERVATION</b>	<b>1. Gender &amp; Age</b>	1. Age variety from 50-early 80, female to male ratio even/ 11 students, more female than male/ 5 female and 2 male/ 6 female to 1 male/	
	<b>2. Exercise Focus</b>	2. MSC muscle Strength Conditioning. / using stretching bands and exercise ball/ Chair Exercise/ Batton Exercise/ Ball Exercise/ Pole Exercise/ Balance Class, Stretching cord.	
	<b>3. Social Aspect</b>	3. They are very sociable and everything is about the communication between participants. /every-one knows each other./ Instructor shares personal stories with the students/ No one is really socializing in this class; every one keeps to them self.	
	<b>4. Lighting &amp; Space</b>	4. It is apparent that the lighting makes a difference in fitness class; there should be natural lighting, or bright room.	
	<b>5. Position</b>	5. The instructor is standing in the middle pointing out to the participants what to do next./ Most students are following accordingly except some that are totally doing their own thing, it seems they are further away. Some ask for instruction moves to do at home.	
	<b>6. Music</b>	6. Fast happy beat. The moves don't really follow the beat	1. There seems to be more female than male attending the classes
	<b>7. Exercise Moves</b>	7. Starting full body stretch for 10 mins (other classes stretch for 5min but for 50+ they do 10mins)/ Exercise ball doing wall squats/ Smaller ball, squeeze and release, subtle ball movement holding with both hands. When setting on the ball we are constantly strengthening the core.	3. I think the social aspect of the class is very good but it seems to distract them from the actual goal of having a strict exercise class 5. The position of the participants seems very important, the ones further away seem to be lost at time. The activity sheet that has the different moves on it is very plain with no images, maybe it would be useful to create instructions specifically for group exercise classes. The instructor suggesting easy moves they can do at home or bus stations/ pointing out the benefits/ 6. It seems in other step classes the steps closely follow the beat but in this class it isn't necessarily like that 2. using calm music for stretching and high beat for warm up 7. Good moves to use for the toolkit. Suggestions of easy to do moves at home, Ball exercise, you can do it while watching TV, throwing ball up and down, squeezing the ball. "She says "these are easy moves you can do while waiting for the bus or while watching TV"./ She says, his is a move you can do while waiting for the microwave, so easy."/

Table 2. Behavioural Observation Categories

**Gender & age:** Based on the observations, the overall rate of female to male ratio in six classes were: session one: even amount; session two: six females to five males; session three: five female to two male; session four: six female to one male; session five: four females to one male and session six: five females to two males. There seems to be more females than males attending the fitness classes (see Table 1).

**Exercise focus:** All instructors focused on MSC (muscle Strength Conditioning), balance and strengthening the core. The common equipment used in all fitness classes

included: stretching bands, exercise balls, chair and batton.

**Social aspect:** In regards to the social aspect of the sessions the researcher made observations that, the seniors were very sociable and everything was about peer communication. Even though the social aspect of the class becomes a major motivation in most of the sessions, it can distract seniors from the goal of having a strict exercise class. For example, at a certain point, the senior socializing activity became so loud that it made it difficult to hear the music. Also, during the water breaks, socializing prevented the class to start on time.

**Lighting & space:** The lighting makes a noticeable and positive difference in the fitness class. Based on seniors preference the fitness class in Carleton Centre was moved from the dark gym to the bright room on the second floor. The instructor noted that “natural lighting and a bright room” makes a positive difference in exercise routine.

**Position:** The position of the participants seems very important, the students further away from the instructor seem to be lost at times and have trouble following the exact exercise moves. Most of the instructors are situated in the middle of the class pointing out to the participants what to do next. The students stand behind or around the instructor, following accordingly. Students that are further away have trouble following the instructors exercise routine.

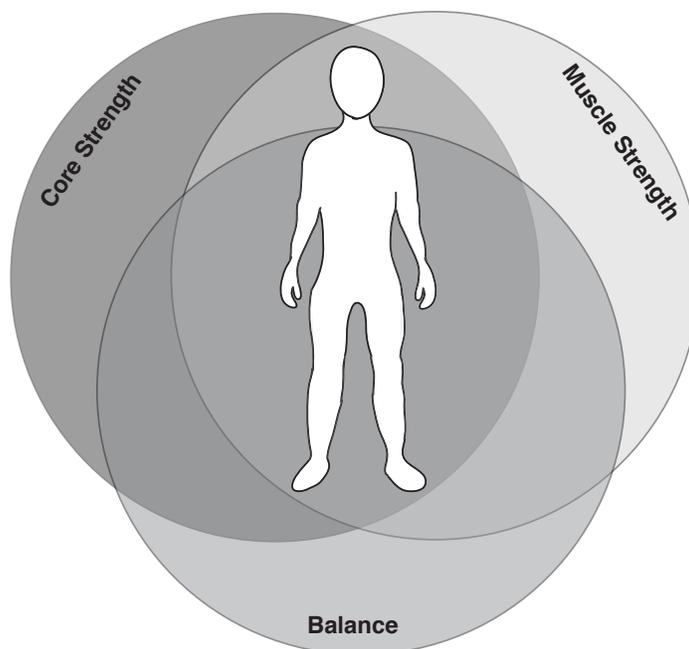
**Music:** The music is typically soft and in the background, it usually has a fast happy beat to it and the moves don't really follow the beat all the time. It seems in regular step classes geared to a younger audience the steps closely follow the beat, but in the senior classes it isn't necessarily like that. The music plays more of a separation cue

between sets of exercises, for example using calm music for stretching and high beat for warm up.

**Exercise moves:** The specific exercise moves and routines observed in classes included: starting full body stretch for ten minutes (as noted by the instructors, fitness classes for the younger demographic do stretching for five min but for 50+ they do ten minutes). After stretching and warming up, they started the combination exercises targeting balance, core and muscle strength. Almost all sessions used the exercise ball doing wall squats and they used smaller balls to squeeze and release; there were also subtle ball movements used in some sessions. Also, all instructors pointed out the fact that the students were working on their core, balance and strengthening muscles when doing wall squats. The instructor informed the student about the benefit of each exercise move. Additionally, the instructor pointed out that each exercise move can be done while doing other activities. This included doing wall squats while watching T.V. or practicing balance when in the elevator. “She says (instructor) these are easy moves you can do while waiting for the bus or while watching T.V”, “this is a move you can do while waiting for the microwave, so easy”.

### **Observations Significant Findings**

1. Exercise Focus: In accordance to the literature, fitness instructors focused on core, balance and muscle strength to reduce the risk of falling (see Figure 5).



Fitness Class Exercise Moves	Literature Review Body Parts
Wall Squats Lunges Balance on one leg	Core & Knee Strength Muscle Mass Balance

*Figure 5. Literature vs. Findings-Activity*

**2. Emotional Approach:** All instructors focused on the benefits of each exercise move and used this approach as a motivational tool.

**3. Exercise Move:** Suggested by instructors, each exercise move (squats, lunges, balance) could be done simultaneously while doing other daily activities. The key findings are summarized in table 3.

<b>FINDINGS</b>	<ol style="list-style-type: none"> <li><b>1</b> Exercise Focus: Balance, core and muscle strength (squats, lunges, balance)</li> <li><b>2</b> Importance of focusing on the benefits of each exercise move</li> <li><b>3</b> Multi-tasking: doing simple exercises in any environment while doing other activities. (watching T.V., waiting for microwave, elevator)</li> </ol>
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*Table 3. Observation Main Findings*

**Research sub-question two:** *What motivates younger seniors to take part in regular physical activity?*

In order to address the answer to the research question, the key findings from the analysis of expert and user interviews followed by diary keeping are provided. The general findings from each method are provided afterwards.

**Expert Interview Findings**

The data from the interviews were categorized into ten main categories, the emerging themes were: 1) Focus For Exercise; 2) Motivation; 3) Senior Concerns; 4) Instructions; 5) Young vs Old; 6) Fall Prevention Exercise; 7) Repetition; 8) Home Based; 9) Info in booklet and 10) Tone (see Table 4).

INTERVIEW WITH EXERCISE LEADERS	CATEGORIES/CODE	OVERALL RESPONSE	COMMENTS
	1. Focus For Exercise	<ol style="list-style-type: none"> <li>1. Compound exercises, a combination of cardio, balance and muscle strength. Chair fitness, exercise without resistance, strength, posture alignment, core and balance.</li> <li>2. Improve life and prevent falls, previous fall, balance improvement, fear of falling, benefits.</li> <li>3. Not specifically falls, overall health. Core instability exercises using weights.</li> <li>4. Hand out with the moves, hand drawn and written instructions.</li> <li>5. Beats per minutes of the music, intensity, change the level and repetition.</li> <li>6. Core strength, strong legs, knees and hips, help balance.</li> <li>7. 2-4 times a week, 30 minutes per cardio and muscle conditioning. Balance exercise should be done every day as well, 30-45 minutes.</li> <li>8. Do things that are fun and easier to do at home. Balance exercises and chair. Being efficient with your time management.</li> <li>9. Simplified workshop, website. The information should be informal and simplified. Raising awareness of their environment, assessing safety of their house. What to wear when going outdoors.</li> <li>10. Light hearted, not serious. Concrete example that they can visualize, in a nice fun way, not laughing at. Make it enjoyable, so they can have fun at the same time.</li> </ol>	<ol style="list-style-type: none"> <li>4. Most of the instructors hand our ready made instructions they create themselves, simplified images that can be improved.</li> <li>8. Based on the pattern I see from all interviews there is a good opportunity to create short and easy to do exercises at different areas of the household or out doors. <i>"when you are in the grocery store line up, balance on one leg."</i> <i>"At home if they have the fitness balls, they can set on that when watch TV, all while you are mindlessly watching the TV. Because they are easy things you can incorporate in your life without taking extra time off."</i> <i>"Yes I do recommend them (home based), some of them actually ask me if they could have a copy of the moves I provide. I tell them to practice at home. Some squads I tell them to do at home, using a door handle and to squad, I tell them to use the environment around them to do the moves, holding on to a door and doing squads."</i> </li> <li>10. Fun and humorous tone is everyone recommendation</li> </ol>
	2. Motivation		
	3. Senior Concerns		
	4. Instructions		
	5. Young vs Old		
	6. Fall Prevention Exercise		
	7. Repetition		
	8. Home Based		
	9. Info in booklet		
	10. Tone		

Table 4. Expert Interview Categories

**Focus for exercise:** Seniors are doing exercises that focus on balance, core and strengthening the leg muscles. These exercise moves can prevent falls. Exercises such as: squats, lunges, balancing on one foot, etc. On average each exercise move should be done three to four times a week for the durations of 30-40 minutes.

**Motivation & senior concerns:** The experts motivate the seniors by using an optimistic, positive tone of voice and repeating the benefit of each exercise. Falling, fear of falling and the desire to live longer were mentioned as the main motivational factors to attend fitness class. When asked, how do the experts motivate seniors to attend class? Three of the exercise leaders replied, "they don't really have that (motivational issues),

they seem motivated enough”. Four of the experts explained how the title of the class becomes important, the seniors do not relate or want to associate to a class that is called “fall prevention”, even though that might be the very reason they attend fitness classes.

**Instructions:** Other than the verbal instructions, four experts provided hand made instructions.

**Home based:** Almost all of the experts mentioned the idea of doing the fall prevention exercise moves at different locations, “like when you are in the grocery store line up, balance on one leg. At home “if they have the fitness balls, they can sit on that when watching T.V., all while you are mindlessly watching the T.V.” More than three experts discussed the idea of multi-tasking (completing more than one task at a time, watching T.V and exercising, etc.) and repetition throughout the day. One expert noted, “Some squats I tell them (seniors) to do at home, using a door handle, I tell them to use the environment around them to do the moves, holding on to a door and doing squats ”.

### **Expert Interviews Significant Findings**

1. Focus for Exercise: strengthening balance, core and leg muscles.
2. Motivation: Tools for motivating seniors to follow-up with physical activity:
  - 2a. Acknowledging the benefits of each exercise move
  - 2b. Fear of falling (fall prevention)
  - 2c. Health & longevity
3. Instructions: Current and available exercise instructions provided by fitness instructors are hand made and paper based
4. Home Based: All instructors recommended repetition of regular exercise move throughout the day while doing other daily activities. The findings are summarized in table 5.

EXPERT INTERVIEW FINDINGS	<b>1. Focus for Exercising:</b> Balance, core & Strengthening the leg muscles	<b>2. Motivation &amp; Senior Concerns:</b> a. Acknowledging benefit of exercise to seniors b. Fear of falling c. Living longer
	<b>3. Instructions:</b> Verbal & hand made paper based instructions	<b>4. Home Based:</b> All instructors recommended repetition of exercise throughout the day

*Table 5. Expert Interview Findings*

### User Interview Findings

The user interviews were conducted to collect data related to the research questions. The data was categorized into 11 main categories, the emerging themes were: 1) Fall Experience; 2) Feeling After Session; 3) Preparation/Motivation; 4) Choice of Class; 5) Exercise Repetition; 6) Companionship; 7) Likes/Dislike Moves; 8) Home Based; 9) Music 10) Group Vs. Individual, and 11) Personal Trainer. The findings are discussed in the next section.

**Fall experience:** Among all participants, five individuals experienced a previous fall and eight participants did not. Individuals who had a fall experience did not have different replies from the participants who didn't experience a fall, nor did this experience influence their responses. This was true for all participants, except one individual who started attending fitness class after she had a fall, and because the doctor recommended it. It is evident that fear of falling or fall experience is not a motivational factor in seeking help through fall prevention exercise. It appears that even though seniors are aware of falling and are seeking prevention, they almost do not want to admit

to this fact. There seems to be a common theme among the senior demographic to avoid anything that is connected to “frailty” and “being old”.

**Feeling after session:** Overall, the feeling and emotions seniors had were positive due to achieving something good for their health and body, at the same time they were relieved that it was over. It is evident that the knowledge of exercise benefits helps seniors go through the challenging routine. For example a participant stated, “I’m a little bit tired, very happy that I came and I’m relieved” another participant said “I feel very good, it is energizing, using muscles you haven’t used in a while. I’m glad it is over though”. Others mentioned, “It is a lot of work and I don’t mind resting afterwards”.

**Preparation/Motivation:** The findings show that there isn’t a lack of motivation among the seniors. Nearly everyone did not have much of a preparation routine before attending class, other than having breakfast, light stretching and warm-up. For example a participant said, “I have my breakfast and get ready and walk to the class.” Another participant mentioned, “I did Tai-chi before I came”. Their main motivation was to meet friends, and exercise, the sense of achieving something became their inspiration, “the group motivates me; I like the social aspect as well.” Already attending fitness classes; exercise becomes part of their life style and routine.

**Choice of class:** None of the participants specifically mentioned fall prevention as their main goal to attend class. The main reasons seniors attended these particular fitness classes included: a fitness class geared to the senior age group, the convenience of the fitness centre being nearby, friend referral, and improving balance and health.

**Companionship:** Overall, companionship did not appear to be a major motivational factor to attend class. Among all participants only 20% attended class with another family member or friend. Meeting certain friends was a motivational factor to 30% of participants.

**Music:** Nine seniors enjoyed the music as a background beat. Other seniors, due to hearing aids and other difficulties considered loud music as a distraction in following the exercise moves. For example, participants mentioned: “I like the music if it’s not too loud, just in the background”, “I concentrate on the instructions mainly, but I like the music in the background.” Others like the music, “if it is soothing and the beat goes with the move”.

**Exercise repetition:** All participants attend class three times per week. There were only three participants who had trouble motivating themselves to attend class regularly. A participant mentioned “I give myself a guilt trip to attend class, only when I feel lazy”; another participant mentioned, “I attend twice a week, I will only miss class if I were sick”.

**Likes/Dislike moves:** Nearly all moves are liked since they are part of a package, “I like them all, because they are head to toe”. The moves that were more difficult and challenging for them to do became the moves they enjoyed the most, the sense of achievement created a liking towards the move. “The ones on the wall, the pushups and squats, I actually like them now, but before not so much since I wasn’t able to do them”. Knowing about the benefit of the move also was a factor in liking a specific exercise move, for example a participant said, “I like the weights. Because I know it is good for me and that women need to build up their bone density, and muscle”.

**Home based:** There were no particular preferences for home based vs. group exercise, but seven participants referred to the combination of home based and group exercise. The common theme of multi-tasking is also emerging in this section. Overall, ten participants pointed out that other than the group sessions they do light exercises while doing mindless work, watching T.V etc. “I do the balance exercise in between the commercials on T.V.”

**Group Vs. individual:** Although most participants don’t mind exercising on their own, group exercise is a motivational aspect for them.

**Personal trainer:** Almost every participant liked the idea of a personal trainer, but the expense and not having the budget were the reasons they did not have a trainer. “No I haven’t, it would be ok but it is very expensive”, “No, no money, if I had the funds I might have had a trainer. I don’t mind doing individual exercise on my own.”

### **User Interviews Significant Findings**

- 1. Fall experience:** Falling was not a motivational factor to do exercise for seniors, due to the reason that all seniors avoided any connection to frailty and falling.
- 2. Feeling after session:** Seniors had positive emotions after each fitness session; this was due to having knowledge about the benefits exercise has for their health.
- 3. Motivation:** Seniors did not experience lack of motivation to attend fitness class.
- 4. Companionship:** Is not considered as a strong motivational factor to attend fitness class.

**5. Home based:** Seniors preferred to have a mixture of home based and individual exercise; they also enjoyed doing mindless exercise along with their daily routines.

**6. Group Vs. individual:** Group exercise was a strong motivational factor for seniors to attend fitness class.

The summary of the key findings is presented in table 6.

<b>USER INTERVIEW FINDINGS</b>	<ol style="list-style-type: none"> <li><b>1. Fall Experience:</b> Not a motivational factor to do exercise</li> <li><b>2. Feeling After Session:</b> Benefits of exercise as motivation</li> <li><b>3. Preparation/Motivation:</b> No lack of motivation was found</li> <li><b>4. Companionship:</b> Not a strong motivational factor</li> <li><b>5. Home Based:</b> a. Mixture of home based &amp; group exercise b. Some do mindless exercise while doing other activities</li> <li><b>6. Group Vs. Individual:</b> Group exercise is a motivational factor</li> </ol>
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*Table 6. User Interview Findings*

### **Diary Keeping Findings**

Based on the data collected the following categories were extracted: 1) Type of Activity; 2) Location; 3) Time & Duration and 4) Companionship

**Type of activity:** The major points found are daily routine and repetition of activities. Knowing that seniors are already following a specific routine in their daily life makes it much easier to add regular exercise to part of that schedule. One of the participants was experiencing health issues for most of the week and wasn't able to attend

group exercise session, “due to health issue was not active.” Another participant was mainly researching on his computer for the week and he took breaks in between, “research using computer, and took breaks in between”. We also see that they are doing certain activities mindlessly “flight of stairs”, “Supper; sat and read while stew cooking”.

**Location:** Certain activities are usually done in the same location and at the same time. Overall the repeated locations included, “neighborhood, living room, kitchen, gym etc.”.

**Time & duration:** It seems most likely the duration and time of the activity is specific as well, walking dog, stretching in the morning, attending classes, etc.

**Companionship:** The activities that are individual such as stretching and walking the dog always stay individual, but having a meal and walking are done with different people. “Dinner at home with a friend”, “Watched some television with my wife”.

### **Diary Keeping Significant Findings**

- 1. Type of activity:** Certain activities are done mindlessly while doing other daily tasks.
- 2. Time & duration:** Seniors follow a regular routine with repetition of activities at the same time and location.
- 3. Companionship:** There is a repetition of certain activities done individually vs. activities done with a companion.

The summary of the main findings is presented in table 7.

<b>DIARY KEEPING FINDINGS</b>	<b>1. Type of Activity:</b> Daily routine and repetition of activities	<b>2. Location:</b> Certain activities are done in the same location and time
	<b>3. Time:</b> The duration and time of activities are specific	<b>4. Companionship:</b> There is a repetition for certain activities that are done individually

*Table 7. Diary Keeping Findings*

**Research sub-question three:** *What are the visual characteristics of exercise instruction artifacts currently used by younger seniors?*

### **Artifact Evaluation Findings**

In order to gain knowledge about the current exercise instructions used by the senior demographic, the researcher gathered current artifacts that included several different types of exercise instructions of different forms of display; they included suggested exercise instructions from the experts. To analyze the artifacts, the researcher focused on the visual characteristics of each exercise instruction. These visual characteristics were utilized to better organize the selection and to make sure a complete variety of visual information was chosen. The visual aspects of the artifacts were divided into six categories: 1) Image; 2) Typography; 3) Color vs. B&W; 4) Tone; 5) Style and 6) Other Info

Overall fifteen different artifacts were gathered and evaluated. This evaluation allowed the researcher to choose a complete variety of current artifacts used by seniors to create

an online survey. This online survey answered the fourth sub-question.

**Research sub-question four:** *What style of exercise instructions do younger seniors find engaging?*

To answer the fourth sub-question and to better understand the seniors' visual preference, an online survey (Websort) was created and conducted.

**Online Survey Findings**

The responses to the survey were gathered in a tree graph, the main cluster of the tree graph was analyzed in table 8 & 9. These analyses included:

- Seniors dislike exercise instructions that are text heavy, visually dominant images are preferred the most. For example three participants considered images 3,5,23 and 24 from table 4 “very busy, hard to read and follow”. Also, instructions that only include text are disliked. For example one participant noted, “it is much easier to follow something with pictures, most people are visually oriented” (Image #25, table 8).
- Light hearted and simple visuals are liked the most. For example two participants noted, “funny and cute, at the same time informative” (image #7, table 8). Other participants mentioned, “I like the simplicity, it is easy to follow” (Image 15 and 20, table 9).
- Exercise instructions using colored visuals are preferred in comparison with black & white images. For example three participants mentioned, “color makes it more attractive and appealing” (Image 2 and 12, table 9).

	CATEGORY/COMMENTS	IMAGE STYLE	TEXT	COLOR/B & W
	3 <i>Busy Instructions:</i> Very busy, hard to read the text/	Sketch	Text Heavy	B & W
	5 <i>Busy Instructions:</i> Very busy, hard to read the text	Sketch	Text Heavy	Color Accent
	7 <i>Fun:</i> Funny and cute at the same time informative/ when it has both explanation and image it is best, gradual development of movement, less text	Sketch	Balanced Text	B & W
	9 <i>Information:</i>	Photo	Balanced Text	B & W
	22 <i>Simple Drawing:</i> Easy to follow and understand	Sketch	Balanced Text	Minimal Color
	23 <i>Busy Instructions:</i> Very busy, hard to read the text	Sketch	Text Heavy	B & W
	24 <i>Busy Instructions:</i> Very busy, hard to read the text	Sketch	Text Heavy	B & W
	25 <i>Information:</i> much easier to follow something with picture, most people are visual, easier to understand	No Image	Only Text	B & W
	26 <i>Information:</i> Gives information/ much easier to follow something with picture	Hand Drawn	Balanced Text	B & W

Table 8. Tree Graph-Online Survey Analysis

	CATEGORY/COMMENTS	IMAGE STYLE	TEXT	COLOR/B & W		
	2	Photo :	Color makes it attractive/ single exercise/ It should have had some explanations.	Photograph	No Text	Color
	10	Photo, exercise without instructions :	They have sufficient and useful image of various exercises/	Photograph	No Text	Color
	12	Information / color:	Having enough explanation on picture helps me to understand it better/ gives information/ I like the simplicity.	Sketch	Balanced Text	Minimal Color
	14	Photo, exercise with instructions :	Full explanation	Photograph	Text Heavy	Color
	15	Photo:	I like the simplicity.	Photograph	No Text	B & W
	20	Information / color:	Having enough explanation on picture helps me to understand it better/ gives information/ I like the simplicity.	Photograph	Text	Color

Table 9. Tree Graph-Online Survey Analysis

### **Online Survey Significant Findings**

1. Four seniors favor simple visuals in the form of drawings
2. Four of the participants preferred color forms to black and white
3. Four senior participants have an easier time comprehending self-explanatory visuals that have minimal text

To find a deeper answer to the fourth sub-question, “*what style of exercise instructions do younger seniors find engaging?*” The analyzed data and key findings from the online survey along with the key findings from fitness class observations; interviews and diary keeping were combined and synthesized. All the overlapping categories and themes were combined into prototype design specifications (Table 11). These specifications, which created the next phase of data collection, are synthesized in the next section.

### **Prototype Design Specifications**

The overall coded data and categories from all of the research methods were combined and reduced to common themes and major categories. The key codes from the researcher, external rater and lit review were merged to five categories: 1) Function; 2) Emotion (behavioural/ attitude); 3) Social Aspect; 4) Environment and 5) Activity Features. The common categories were synthesized into design specifications for exercise instruction prototypes (See table 10).

### AFFINITY DIAGRAM – ALL RESEARCH METHODS KEY CODES

FUNCTION	EMOTIONS (Benefit/Attitude)	SOCIAL ASPECT	ENVIRONMNET	ACTIVITY FEATURES
1. Motivaton 2. Prevent Injury 3. Flexibility 4. Measuring progress 5. Ease of performance 6. Instructions	1. Feeling of well-being 2. Challenge 3. Tailored for needs 4. Feeling safe 5. Health benefits 6. Engagement 7. Fall experience	1. Companionship 2. Group vs. Individual 3. Young vs. Old	1. Accessibility 2. Convenience 3. Positive atmosphere 4. Lighting 5. Music 6. Ambiance 7. Tone	1. Fall prevention exercise 2. Repitition 3. Verbal instructions 4. Time 5. Style of exercise

#### DESIGN SPECIFICATIONS FOR PROTOTYPE INSTRUCTIONS:

**Function:** Motivating, prevent injuries, flexible, physical progress measurement, easy to perform instructions

**Emotions:** Feeling of well-being, challenging, geared towards physical needs, safety, knowledge of health concerns & benefits, engaging

**Social Aspects:** There should be an option of companionship, doing the exercise with a partner and individually

**Environmental Criteria:** The environment of the exercise activity should be accessible, convenient and with bright positive atmosphere

**Activity Features:** The exercise should be geared towards fall prevention with different styles and repetitions

*Table 10. Prototype Design Specification*

Based on the gathered data, the design of the exercise instruction prototypes should follow these key features:

**Function:** The prototype should have elements that imply motivation, consider physical progress measurement, provide the opportunity for flexible use anywhere and at anytime, be easy to perform and prevent injury.

**Emotions:** The prototype should create a positive feeling of well being, be challenging enough to engage the user, be geared towards physical needs, consider the users safety, raise awareness and knowledge of health concerns & benefits.

**Social Aspects:** Based on the findings, the social relationships played an important role in physical activity for seniors. There should be an option of companionship, doing the exercise with a partner and individually.

**Environmental criteria:** The environment and surrounding of exercise was found to be an influential element. The environment of the exercise activity should be accessible, convenient and with bright positive atmosphere.

**Activity features:** The focus of the exercise should be geared towards fall prevention, taking use of different styles and repetitions.

The findings from the expert and user interviews created a new insight for the researcher. Comments from the experts indicating that the seniors who attended fitness classes did not lack motivation and that socializing was an important factor for the seniors to attend class. Also, comments from the users mentioning that they prefer a mixture of group and individual exercise, more than two seniors pointing out that they use all their energy in fitness sessions and that they do not have time to do a set exercise program at home. Based on all these findings, this question came to mind: If the group exercise is what most seniors prefer and this becomes a motivational feature for them, is a home-based exercise really needed? The researcher came to a conclusion that there isn't necessarily a need for a complete set of home-based fall prevention exercises. The need for having instructions or "reminders" for doing different fall prevention exercise moves anywhere and anytime became a more prominent solution. Based on this insight, using the prototype specifications, the next stage of the research was designed.

**Main Research Question:** *How can exercise instructions be designed to be engaging and visually appealing to motivate seniors to do regular home-based exercises specifically for fall prevention?*

### **Prototype Evaluation**

The data collected from the prototype evaluations and the common themes found from all research methods were refined and categorized into seven groups (see Figure 5):

- 1) Figure Representation;
- 2) Environment;
- 3) Benefit;
- 4) Format;
- 5) Time;
- 6) Motivation;
- 7) Composition (a. Readability b. Ability to Follow).

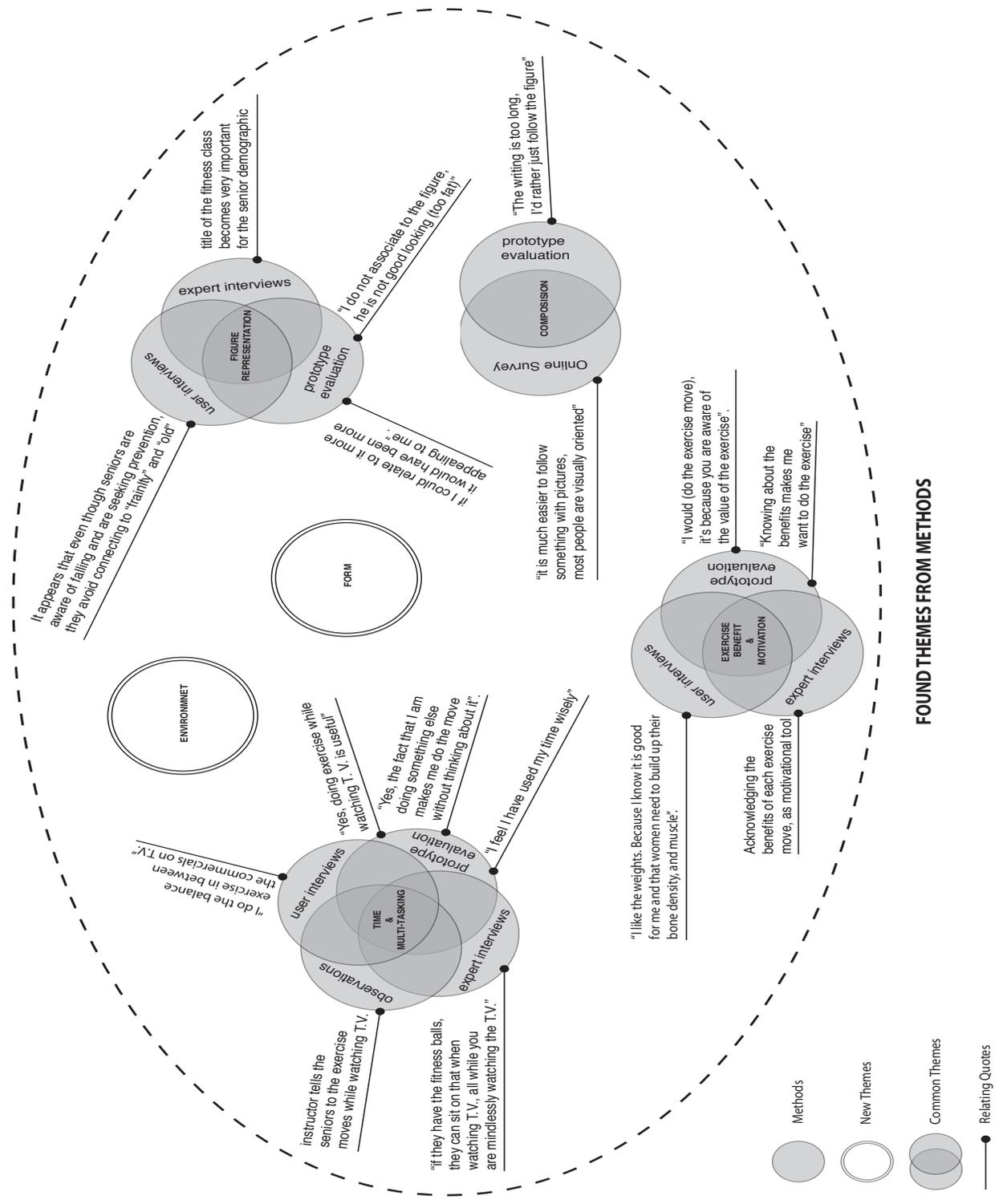
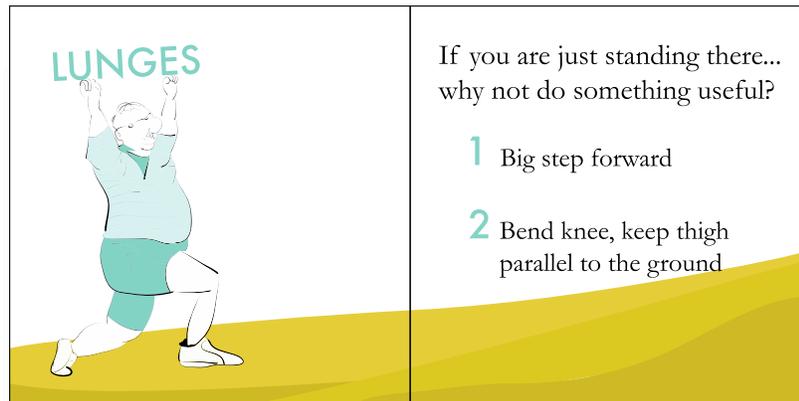


Figure 6. Found Themes

## Findings

### Figure Representation:

- Among all responses the actual figure is being criticized the most; the need to relate and associate with the figure is a major point here. “I do not associate to the figure, he is not good looking (too fat)” (Figure 7); “the figure is not complimentary, not inspiring, if I could relate to it more it would have been more appealing to me”.
- Not relating to the figure makes the user think the fall prevention exercise is not for him or her. “Overwhelmed by the over weight person; I’m not nearly like that.” They seem to be discouraged/encouraged to follow through with the exercise because of the figure.
- Even though the figure is a representative of the demographic they do not want to associate with them and would rather have a superficial figure that they want to look like. “The figure is too large and looks obese which I don’t relate to, I don’t think it’s for me when she is too large”. This common theme is found in the expert and user interviews, the tendency of not relating to anything that represents “frailty” and “old-age”. The experts mentioned that the title of the fitness class becomes very important for the seniors. Senior centers that had fitness classes called “fall prevention” had to discontinue the program since no one registered, and the same class with the title “balance and core” had a waiting list.
- Although the users didn’t necessarily relate to the actual figure, they preferred simple cartoons and information. “I like the simple design”.



*Figure 7. Exercise Instruction Prototype-A*

**Environment:**

- The environmental cues help the participant to situate themselves better to follow the exercise move, that can be an important point for guiding them to correctly follow the instructions. “It would have been easier if there were a wall” (figure 8), “not having a wall made it unclear” (figure 8).
- Also hinted that the background and situation can help the seniors to do the exercise, “seeing the elevator background is nice, it situates me more” (figure 13).
- Not being required to have a specific environment and area to do each exercise is important as well to the participant. This gives an opportunity for the participant to choose his or her own scenario, the instructions becomes a guideline for good health here. “(Would I do the exercise?) For sure, doesn’t require special place or

equipment, you can do them anywhere”.

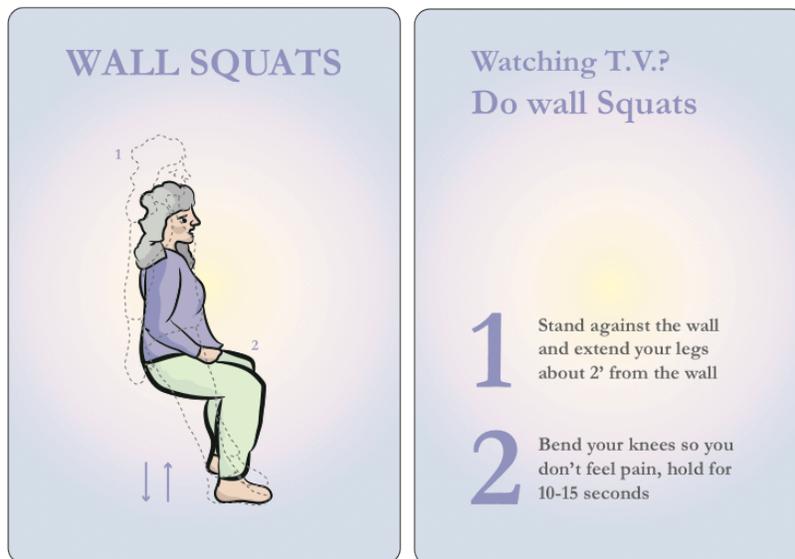
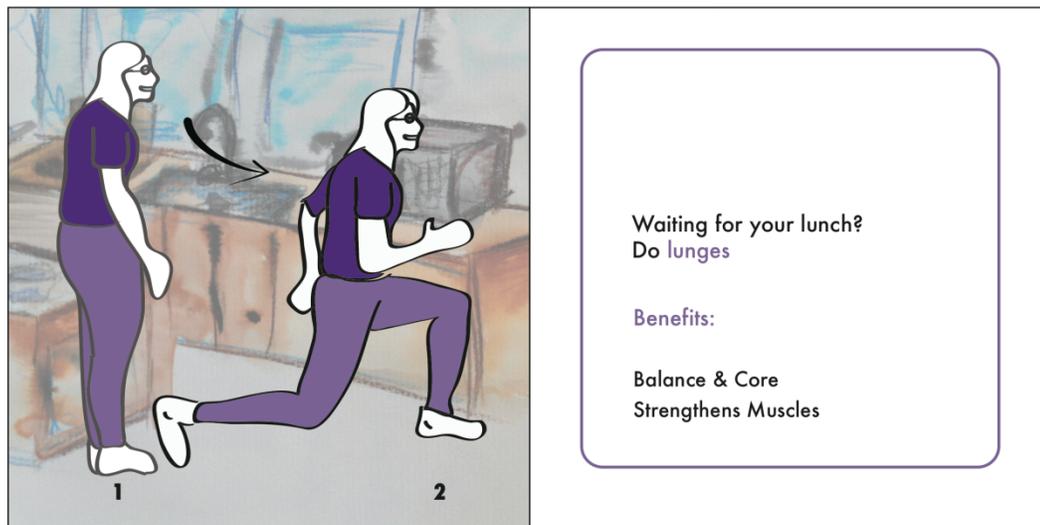


Figure 8. Exercise Instruction Prototype-B

**Benefit/ motivation:** Knowledge of the exercise benefit and motivation towards exercise has a close relation to this section of the study. Knowing about the benefits becomes a motivation factor to follow-up with exercise. “Knowing about the benefits makes me want to do the exercise” (Figure 9). The awareness makes the task more appealing to do and to follow. “I would (do the exercise move), it’s because you are aware of the value of the exercise”. If the participant doesn’t know what they are getting out of it they are less likely to do the task. “Yes, maybe if I knew why, I would be more Motivated (to do the exercise)”. This common theme, acknowledging the benefits of exercise as a motivational factor, is also found in fitness class observations, expert and user interviews.



*Figure 9. Exercise Instruction Prototype-C*

**Format:** It seems there is more preference towards the card format vs. booklet, because of the practicality of carrying and reading. “I like the card more than the booklet, it is easier to handle”, “The practicality, I’d rather have a card than a booklet”, “Takes less space to carry” (Figure 10). Having all the major information to do the move on one side and the benefits (secondary) information on the other side makes it easier to read and follow. “I like how all the info is on one side and the figure is separate, I think it’s easier to follow”. Three participants prefer figure 10, which is a 5x5 card. “Overall I like the shape and size of this card”, “like the size and shape of the card”, “I like how it is double sided, the curved corner and the title being isolated in the corner”

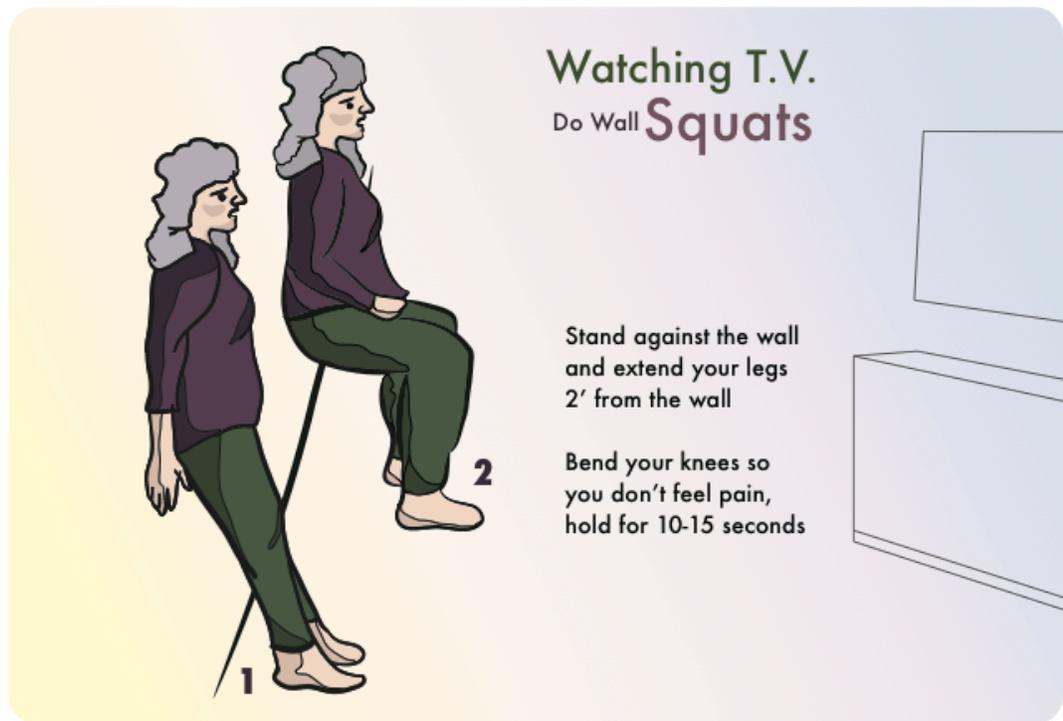


Figure 10. Exercise Instruction Prototype-D

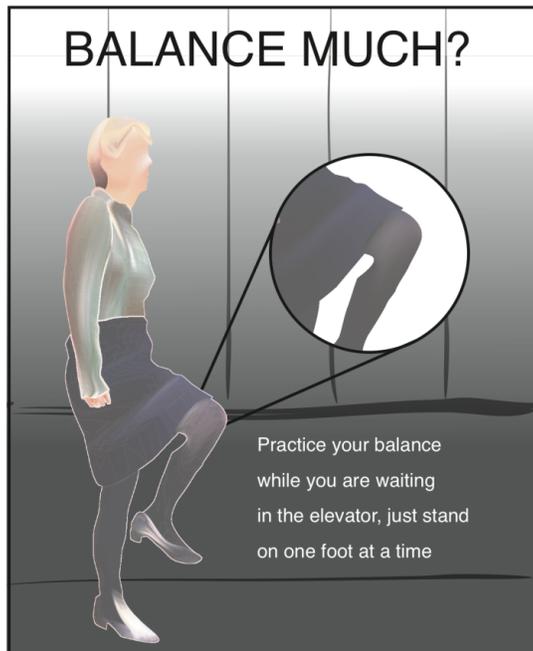
**Time:**

- In regards to doing an exercise move while doing another task, two participants are using the term “useful”. “Yes, doing exercise while watching T. V. is useful” (figure 11), “Yes, it’s a very good idea, times that you are just standing, very useful” (figure 13), “I feel I have used my time wisely”. The seniors view the exercise move a good use of time.
- Also, the term “pass the time” is used, so they don’t see it just as an exercise that is good for your health but something that can help pass your time, “yes, absolutely, helps pass time”, “Very helpful to pass time”.
- Furthermore, “time efficiency” and “multi-tasking” becomes appealing and could be an element of motivation. The fact that the user doesn’t see the exercise as a task, doing it without knowing or paying attention is an interesting point. “Yes, the fact that I am doing something else makes me do the move without thinking about it”.

The common theme of multi-tasking and doing exercise with other daily tasks is also found in user and expert interviews.



*Figure 12. Exercise Instruction Prototype-E*

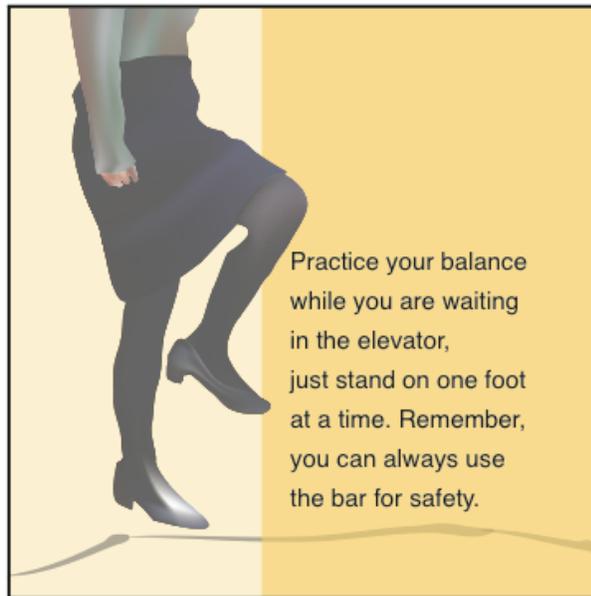


*Figure 13. Exercise Instruction Prototype-F*

**Composition (readability and the ability to follow):**

- If there is little text it should just be on the same page, if the text needs to be long (benefit section) it should be on separate pages. “Information (directions) is more clear and easier to read when all in one page ”.
- The seniors pointed out that this typeface (Futura) is easier to read and follow, “The information is very clear, easy to read and follow” (Figure 12).
- The seniors prefer point form, short and concise information. “Image and text are separate and I like it better”.
- It is easier for the user to follow the instructions just by looking at the clear image, without the need to read the steps. “The writing is too long, I’d rather just follow the figure” (Figure 13).

- A strong catch phrase can bring the instructions to the user's attention. "Yes, the phrase (it's lunge time) caught my attention, it is appealing to do" (Figure 10).



*Figure 13. Exercise Instruction Prototype-G*

## **Summary**

The summary of the studies key findings include:

1. Older people find illustrations showing healthy and fit figures more appealing, this increases their sense of engagement and motivation.
2. Exercise instructions can be used as a health guideline and reminder that allow seniors to incorporate fall prevention exercise in their daily routine. The concept

of multi-tasking is a strong motivational factor that encourages seniors to do exercise while doing other daily tasks.

3. Acknowledging the benefits of each exercise move is a strong motivational factor for seniors to follow-up with a regular exercise routine.
4. Not having a specific environment and equipment for exercising appeals to the seniors.
5. Seniors visually prefer image dominant instructions that are self explanatory with minimal text.
6. Seniors prefer the format of a 5x5 card vs. booklet; the size of the card is convenient and portable.
7. Using a strong catch phrase is a motivational tool that can encourage seniors to engage with the exercise instructions.

In the next sections these concepts and themes are further developed and synthesized into design recommendations and concept.

## CHAPTER 5—DISCUSSION

The findings of this study have revealed new insights and have confirmed what the researcher had gathered from the literature review. Based on the findings, developing simple, figurative, exercise instructions that supplement other activities is a useful preventative measure, by motivating seniors to do fall prevention exercise. In this section, the researcher discusses how this found knowledge could make a difference with regards to the main research questions. Based on the research framework, each category is discussed and synthesized into design recommendations and a concluding conceptual framework for future designers. Section I & II introduce the relation between exercise and seniors by discussing section 5.1 & 5.2. Section III introduces instructional design by discussing section 5.3, 5.4, 5.5, 5.6, & 5.7.

### **Section I & II: Fall prevention & Independence**

This section addresses the first two aspects of the research framework (Independence & Falls for Older Adults, Fall Prevention & Exercise for Older Adults). These sections also organized the studies literature review, followed by section III.

### **Motivation Towards Exercise & Seniors**

Based on the literature, this study was initiated with the assumption that in order to prevent falls, seniors needed a set of fall prevention exercises that created motivation to do regular physical activity. However, even though the Centers for Disease Control

and Prevention noted that among those engaged in physical activity, adherence rates reveal only 15-30% of elderly actually participate in regular sustained activity (Centers for Disease Control and Prevention, 2003), the data illustrates that the seniors who are healthy enough to take part in physical activity, do not lack motivation. The data extracted from the literature review was based on a larger sample size that included individuals taking part in exercise as well as seniors who are not active. This study's focus was on seniors already active in physical activity. This statement is extracted from data collected from expert and user interviews. Three experts note, “the seniors don’t really have motivational issues, they seem motivated enough”. In addition, more than ten seniors confirmed that they are not experiencing lack of motivation. For example a participant noted, “I’ve done exercise all my life and it’s been part of my life so I don’t really need motivation”. Therefore, motivation to attend group exercise is not necessarily lacking in seniors. Initially, based on the gathered literature, the researcher focused on home based exercise that creates motivation. Even though seniors were found to have enough motivation to attend group fitness classes, there was a need found for regular exercise reminders that motivated regular exercise throughout the day. Since the findings show that seniors are already motivated to attend group exercise classes, it may be possible to provide exercise instructions that integrate into seniors’ ongoing everyday routines.

### **Home-Based & Group vs. Individual Exercise**

Based on the literature the main reason seniors were not able to attend group exercise classes were the cost and accessibility of the classes (Shih et al. 2006; Rimmer et

al., 2008; Schoenberg, 2008). Due to this finding, in order to avoid membership costs, the main research question and methods were designed to investigate the need for home-based exercise. This fact was also confirmed in the user interviews, when asked if the seniors would have a personal trainer, all seniors replied “No”, based on not being able to afford the expenses.

On another note, Hickey et al’s research in 1992, suggested that exercising in a group could enhance mental stimulation and life satisfaction (Hickey et al., 1992). Also, Mingue’s study suggested incorporating a supportive significant other or social network into the exercise regime in order to increase compliance (Pfister-Mingue, 1993). In accordance to the literature, when the seniors were asked if they preferred group vs. individual fitness session? Most participants mentioned that “the group exercise and meeting their friends” became a motivational aspect for them. Others mentioned that they “prefer a mixture of both group and individual exercise” and two participants said “there is no time for both (group and individual exercise), that is why I put all my energy in this class”.

Based on the literature and research findings, it is evident that seniors might have cost issues to just follow group exercise, but on the other hand the group and companionship is a motivational issue. In order to have a mixture of both, it seems the opportunity of having lighter fall prevention exercise that can be done at home or elsewhere, individually or with a companion, is a great option. This found option becomes a significant finding, even though it was not widely discussed by the literature, it was partially mentioned by Hickey et al. and Pfister-Mingue and confirmed by the field

findings. The combination of field findings and literature confirmations signifies this found opportunity.

### **Section III: Instructional Design Assessment & Factors**

#### **Seniors responses to Figure Representation**

There seems to be a common opinion among the senior demographic to avoid anything that is connected to “frailty” and “being old”. In accordance to the literature, it would be more difficult to target elderly for an exercise intervention since they deny falling and consider it as a reminder of increasing frailty (Battiato, & Owens, 2012). This common pattern is initially observed in expert interviews. The exercise leaders explain how the title of the class becomes important; the seniors do not relate or want to associate to a class that is called “fall prevention”.

Secondly, the researcher takes note of how differently seniors and experts view “fall experience”. Experts consider “fall experience” as a motivational factor to attend fall prevention exercise sessions, whereas seniors who actually had a “fall experience” do not consider their experience differently.

Lastly, a major pattern in the prototype evaluation responses was connected to identifying with the figure representation. This was also found in Strickler & Neafsey (2000) study, they note that older adults prefer designs of figures, which are associating, relating, appealing, complimentary, and with attractive facial expressions. The prototype evaluation findings confirm the fact that, even though the figure is a representative of the demographic, they do not want to associate to it. Seniors rather have a superficial figure

that they would want to look like. For example a participant said, “the figure is not complimentary, not inspiring, if I could relate to it more it would have been more appealing to me to do the exercise”.

It seems the senior’s perception of the visuals and the emotional response they have to the instructions can influence their motivation towards the activity. In accordance to Stokols and King, certain health behaviours such as adherence towards physical activity can be influenced by personal and environmental variables (Stokols, 1996; King et al., 2002). These variables include the emotional reactions one receives by using a product and the response they make to that emotion. Also, Norman points out those aesthetically pleasing objects enable the user to work and react better (Norman, 2004). This confirms the point that when visuals become appealing and create pleasure for the seniors, they become motivated. In accordance to this, Chisnell points out that pleasurable design can increase the user abilities to accomplish a new routine and to gain a larger perspective in using the instructions (Chisnell, 2012). Jordan also confirms this, when users experience “displeasurable” emotions and fail to reach psycho-pleasure, they will not achieve the task the product is trying to communicate (Jordan, 1996). The more the seniors relate to a figure and find the visuals appealing and pleasurable, the more motivated he or she will be to follow the exercise instructions.

### **Exercise Benefits & Motivation**

Another common theme found in the analyzed data is the relationship between “motivation” and “awareness of exercise benefits”. This is first found in the interviews with the experts. The experts used the benefit of exercise moves as a tool to motivate seniors to attend class regularly. On the other hand, according to the senior interviews

one aspect that created motivation to attend sessions regularly was having “knowledge of the exercise benefits”. Additionally, this pattern is analyzed in the evaluation of exercise instruction prototypes. Most evaluators mentioned “exercise benefits” as a motivation factor to follow up with physical activity. This new finding was not discussed in the literature review sections of the study.

On another note, having a strong catch phrase that would be inviting to read the instruction cards was found to be appealing and motivating. This fact is considered a new finding, which was not discussed in the literature review. It becomes evident that the knowledge and awareness about exercise benefits is a motivational factor for seniors.

### **Multitasking & Time Efficiency**

The notion of multi-tasking and time efficiency is a common theme found in different scenarios in the collected data. This theme was initially found in class observations, expert and user interviews and eventually utilized in prototype evaluation phase of the study. The exercise leaders guided the seniors to do exercise moves while watching T.V. or when in the grocery line. In addition the seniors mention that they do exercise in between “T.V. commercials” and “while waiting for the food to cook” in the kitchen. More importantly, the prototype evaluators positively noticed the notion of multitasking that was introduced through the prototype exercise instructions. Almost all participating evaluators mentioned that the aspect of multitasking and time efficiency motivated them to do the exercise. Some participants said “Yes (I would do the exercise move), it’s a very good idea, times that you are just standing, very useful” others noted, “I feel I have used my time wisely”.

It seems a trend of multi-tasking is being introduced in our society, since individuals are already applying it without even knowing. Research indicates that 68% of T.V. viewers multitask while watching their favorite shows, like surfing the web (Wang & Tchernev, 2012) and so much more. As an example, to prevent the incontinence issue amongst females the “Kegel Exercise” is introduced (Vidya & Vidhya, 2012). This exercise is promoted because there is no need to do the move in a special environment or at a specific time. The “Kegel exercise” promotions focus on multitasking and doing these simple exercises in any environment while doing other activities. For example, you can perform them while sitting at the computer, eating a meal, and watching TV (Depends, 2013). The idea of doing different activities at the same time is an appealing factor to the seniors and motivates them to do fall prevention exercise; the notion of multi-tasking is considered a great motivational factor.

### **Purpose of Exercise Instructions (environment & surrounding)**

Based on the findings from the prototype evaluation phase of the study, the researcher found a new purpose for the exercise instruction. Other than the obvious purpose of being to guide the user to properly follow the exercise steps, the exercise instructions become a “reminder” and “guideline” for healthy choices and style of physical activity. Most users and participants were aware of the specific exercise moves illustrated in the prototype instructions, but the idea of doing them anywhere and anytime was a new notion. The idea that they can use the instructions as a reminder to situate themselves in different everyday scenarios is a new insight from the collected data and observed behaviour in prototype evaluation. For example, when a participant was asked, if they would do the exercise, she responded: “For sure, doesn’t require special place or

equipment, you can do them anywhere”. Additionally, to correctly follow the instructions and to better situate themselves in the surrounding, certain environmental cues were needed for the user. For example, three participants noted that having a wall in the image was useful for them to follow the instructions correctly. This was a new finding that was not discussed in the literature. When exercise instructions become a “reminder” and “guideline” for healthy choices, they can motivate seniors to do exercise as a life habit. Also, using environmental cues helps the users to situate themselves correctly.

### **Format & Composition**

According to the prototype evaluation findings, seniors preferred the 5x5 inch card format to a booklet. This format was found to be convenient and easily portable. Also, the seniors found it easier to comprehend information that was separated, and text that had shorter lines with larger text. The literature— Strickler & Neafsey’s study— also confirmed that bold type is easier for seniors to read (Strickler & Neafsey, 2000). Older adults need a larger type size than younger readers to read text comfortably (Kline & Lynk, 1993; Morrell, & Echt, 1997; Nini, 2006). Strickler & Neafsey also note that it is easier for seniors to comprehend the text with paragraphs of five lines or less which was image dominant (Strickler & Neafsey, 2000). Seniors will benefit by having the exercise instructions in a practical and portable 5 x 5 inches card. Also, readability and ability to follow instructions will increase by separating primary and secondary info. Focusing on a clear image will minimize the need of text. Table 11 presents summary of the previous discussions.

## SUMMARY

- 1.** The more the seniors relate to a figure and find the visuals appealing and pleasurable, the more motivated he or she will be to follow the exercise instructions.
- 2.** The knowledge and awareness about exercise benefits is a motivational factor for seniors.
- 3.** The notion of multi-tasking is considered a great motivational factor.
- 4.** Exercise instructions become a “reminder” and “guideline” for healthy choices. Using environmental cues helps the users to situate themselves correctly.
- 5.** Exercise instructions are more practical and portable as 5 x 5 inch card. Ability to follow instructions will increase by separating primary & secondary info. Focusing on a clear image will minimize the need of text.

*Table 11. Discussion Summary*

### **Design Recommendations**

According to the previous discussed findings, the researcher developed a set of design recommendations (Table 12). The extracted recommendations are intended to be a set of guidelines for future designs for designing instructional exercise graphics for the elderly demographic. These recommendations provide an answer to the main research question:

*How can exercise instructions be designed to be engaging and visually appealing to encourage seniors to do regular home based exercises specifically for fall prevention?*

The recommendations are divided into six categories, four categories targeting the essence of the exercise instruction design and two categories recommending the format of instructions:

**AFFINITY DIAGRAM – PROTOTYPE EVALUATION FINDINGS**

Figure Representation	Benefit & Motivation	Time	Environment/ Surrounding	Format	Composition: Readability Ability to Follow
1. Association 2. Ability to relate 3. Appealing 4. Complimentary 5. Facial expressions	1. Awareness 2. Benefits Motivates 3. Catch Phrase	1. Useful 2. Pass time 3. Multi tasking 4. Time efficiency 5. Do the move (exercise) without thinking about it	1. Environmental cues 2. No special 3. Anywhere & Anytime	1. Practicality (card more then the booklet) 2. Storage (Card is easier to carry) 3. Size and shape (5x5)	1. Readability: a. Picture and directions are in one sheet b. Info on separate side 2. Ability to Follow: a. Easier to follow when image is separate b. Minimal text

**DESIGN RECOMMENDATIONS FOR EXERCISE INSTRUCTIONS:**

**Figure Representation:** Associating, relating, appealing, complimentary, attractive facial expression

**Benefit/Motivation:** Including benefits to raise awareness and motivation, including a strong inviting phrase

**Time:** There should be a focus on multi-tasking and time efficiency

**Environment/ Surrounding:** Using cues for surrounding, activity done anywhere and anytime

**Format:** Practical to have a portable card with the size of 5x5

**Composition:** Separation of primary and secondary info to increase readability and ability to follow instructions, focus on image with minimal text

*Table 12. Design Recommendations*

**Figure representation**

**In order to increase motivation and positive emotion, design appealing visuals that seniors can relate to.** The more seniors can relate to and find pleasure from the figure, the more they will be engaged and motivated to follow the exercise instructions.

**Benefit & Motivation:**

**Incorporate an inviting phrase to engage the user and include a benefit section for each activity.** It was found that including a strong inviting phrase “catch phrase” creates motivation and desire for the participant. Raising awareness about the benefit of each exercise and explaining why seniors should follow such routines was also found to be a major motivational aspect for the seniors.

**Time**

**There should be a focus on multi-tasking and time efficiency in exercise instructions designed for seniors.** The notion of saving time, making use of time and multi-tasking is an appealing factor to the seniors demographic, encouraging them to incorporate physical activity in their daily routine.

**Environment & surrounding**

**Use graphic cues for exercise surrounding.** The environment and surrounding of the instructions should be represented because they are an important functional factor in helping seniors follow the instructions more easily and more comfortably.

**Format**

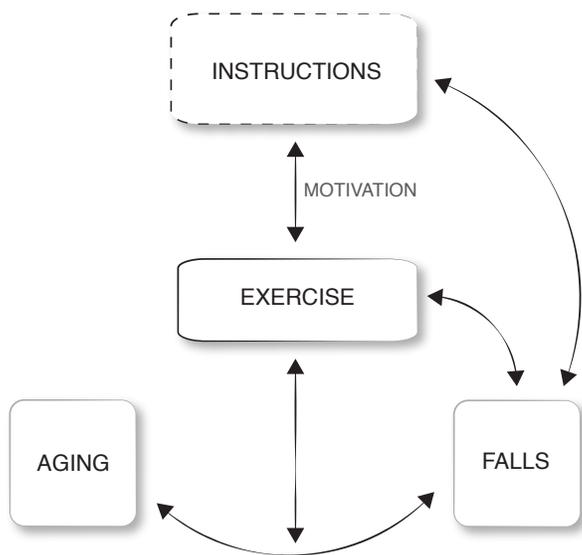
**Use a practical and portable card with the size of 5x5 inches.** Based on the prototype design findings, seniors will benefit by having the exercise instructions in this portable format.

## Composition

To increase readability and ability to follow instructions, separate primary and secondary information. Focusing on a clear image will minimize the need for text.

### Conceptual Framework

There is a clear relationship between aging, risk of falling, and designed exercise instructions according to the literature review, the study findings and the recommendations. Based on these relationships, the researcher has developed a conceptual framework (see Figure 16).



*Figure 14. Instruction Design vs. Senior Falling- Conceptual Framework*

The literature review and expert interviews confirm the fact, that with aging the risk of falling increases. Also, these two sources verify the fact that with regular, early on exercise, the risk of falling can be reduced among seniors. The findings from the prototype evaluation confirm that simple, figurative, exercise instructions that are designed to supplement other activities, can be a great motivational feature for seniors to do regular exercise. For example the more an individual ages the higher the risk of falling becomes. The higher level of regular exercise decreases the chance of falling with aging. With more motivation created by exercise instructions, the more likely an individual will take part in physical activity and more likely they will reduce the risk of falling. In figure 16, “instructions” and “motivation” is particular concerns for design, these two variables can be influenced with different design features.

Therefore, simple exercise instructions that supplement everyday activities increase motivation and engagement to do regular exercise; and ongoing regular exercise can be a preventative measure in the risk of falling.

## **Summary**

Three sources of information (literature, user and expert interviews) discussed the common theme of seniors not associating to frailty and old. These sources agreed that when seniors relate to a certain figure and find the visuals appealing they will engage with the activity, therefore they would be motivated to follow the instructions. Also, information from literature and prototype evaluation both confirm that in order to increase senior comprehension, there is a need for image dominant compositions. Instructions with large, bold text, which are organized in, separate paragraphs with short

lines were considered easier to read. Additionally, both sources (lit review, user and expert interviews) discussed the issue of expenses for seniors to attend classes, and the role group and socializing plays in motivation.

There were also some elements that were not mentioned by all sources of information. The fact that acknowledging exercise benefits could create motivation for seniors, was only discussed by expert interviews and prototype evaluation. The relation between exercise benefits and motivation was not discussed in the literature. Also, the notion of multitasking was only discussed in prototype evaluation, expert and user interviews. Additionally, all sources except the literature played a role in giving a new role to the purpose of exercise instructions.

There was also some disagreement in relation to seniors lacking motivations. The sources from the literature mentioned lack of motivation among seniors, while the observations, expert and user interviews disagreed. This eventually guided data collection into a new direction. However, the majority of the findings supported and elaborated on one another.

### **Limitations**

As with every research project, the study faced some limitations. Due to the small number of expert interview informants, the responses are relatively limited. Only one expert from the physiotherapy field was interviewed and the other five informants were exercise leaders and trainers. With more resources, the researcher could take advantage of a balanced group of experts from the physiotherapy discipline.

In addition, other than interviewing and observing active seniors, further research can benefit from interviewing seniors that are not part of exercise classes and are not physically active. Also, in the time frame defined by the research program the researcher was not able to recruit more seniors from different backgrounds.

Finally, the designed prototype included limited amount of styles, for future research having a larger variety of designs would have been beneficial.

## CHAPTER 6—CONCLUSION

This research was approached from an interdisciplinary perspective, using mixed methods to explore the subject of designing engaging exercise instructions for seniors.

This study was interdisciplinary by having an instructional design researcher based in the field of design using a user centered HCI/ psychology approach to understand the context and needs of seniors in relation to fall prevention exercises.

The three most important findings to note in designing fall prevention exercise instructions for seniors are:

1. There is a need for a set of exercise reminders to incorporate regular physical activity into the daily routines of seniors.
2. These exercises can be done at the same time as other activities, such as watching T.V in order to encourage multi-tasking. A major element that creates engaging and pleasurable design is incorporating the notion of multi-tasking in exercise instructional design.
3. Seniors react negatively to stereotypical representations of them as old, whether it is in a title of a class or in figurative illustrations. More importantly, relating to a certain appealing figure creates a sense of engagement and pleasure that motivates and encourages the user to follow exercise instructions.

The information derived from this research is compiled into a set of recommendations and conceptual framework that when combined, can create an engaging, pleasurable design that encourages and motivates senior users. The resulting recommendations and theory can act as a tool or guideline for designers who wish to develop engaging instructions for the senior demographic.

### **Future Research**

This initial study creates opportunities for future research to build on the knowledge developed. The recommended design elements that can increase motivation and encouragement could be studied further by applying them to actual instructional graphics. This can be tested to see if the results are perceived as anticipated. Also, while this study addresses senior's motivation to follow fall prevention exercise, an ethnographic study could also be preformed to observe the use and effect of the instructions.

Further more, utilizing a greater range of sample users can further develop this research. Data can be collected from seniors with a wider age range, education, etc. This can introduce a new avenue in the design of exercise instructions for the older adults. A wide range of users can create a need for different design features that can be further developed. Accordingly, the list of design recommendations could be reworked in the future based on the wider demographic range. Additional elements could be included, such as the implications of a group dynamic, while some of the less supported elements may be removed.

Lastly, testing the connections between regular exercises, physical activity and falling can further develop the conceptual framework of this study. Future researchers can test this framework to better understand the relationship between each variable and to track the physical change each user.

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## APPENDIX A

### External Rater Table-Fitness Class Observation

Researcher	Rater #1	Matches	Reference
<b>1. Social Aspect</b> 2. Gender & Age <b>3. Type of Activity</b> <b>4. Lighting &amp; Space</b> <b>5. Position &amp; Attitude of Instructor &amp; Class</b> <b>8. Exercise Moves</b> 7. Music	1. <b>Social</b> 2. Personalization 3. <b>Gradual level increase</b> 4. <b>Location vs. performance</b> 5. <b>Flexibility</b> 6. <b>Progress</b> 7. <b>Positive atmosphere</b> 8. <b>Ease vs. performance</b> 9. <b>Challenge</b> 10. <b>Verbal instructions</b> 11. <b>Engagement</b> 12. <b>Repetition</b> 13. Potential benefit	X  X  X  X X X X X X X X X	1. "They are very sociable and everything is about the communication between participants" 3. "The beat has become faster and steps are considered to be faster as well, not as gentle and slow as before" 4. <i>Location/Space</i> : "It is apparent that the lighting makes a difference in fitness class; there should be natural lighting, or bright room" 5. <i>Challenge</i> : "Some people challenge them self's and do the step while holding weights" Attitude of instructor/verbal instruction: "Instructor guides them by saying how many they have done and how many steps are left to do?" 8. <i>Moves/Repetition</i> : "Standing in front of the chair, legs wide to shoulder lifting each arm that is holding a weight up and down in front of them, repeating move"
		<b>Matches: (11/13) 85%</b>	

# FITNESS CLASS OBSERVATION

(Interpreted Phrases)

## APPENDIX B

## Expert Interview Questions

## Fitness Class Leaders:

1. How long have you been instructing fitness classes?
2. How long have you been instructing fitness classes geared for the seniors?
3. What are the specific exercise moves you focus on for the seniors?
4. In your experience, what motivates adults in the 60-70 age group to seek measures for preventing future falls?
5. What sort of experience have you had with people in the 60-70 age range, who have not previously had a fall, regarding concerns about falling as they go about their daily activities? (such as using stairs)
6. What form of information and exercise instructions do you provide to your clients?
7. Do you conduct fall prevention fitness classes? If yes, what are the different moves you provide? Does this change with different age groups, e.g 50+ classes versus 60+ classes?

8. In your experience, what particular exercises are best for reducing the risk of falling, and being prepared for different types of challenges that could lead to falling?
9. Can you refer me to existing exercise programs that are geared towards fall prevention?
10. How often should each set of exercise be repeated in a week in order to receive a positive outcome in regards to reducing and preventing falls?
11. Do you recommend that your clients repeat certain exercise moves that you do in class at their own home? If yes, why and could you provide examples? If no, why not?
12. Can you give an example of a case that a client didn't attend all of your fitness classes and if you helped them achieve their goal in attending all sessions? How?
13. What are the differences for you between conducting a senior exercise session vs. a session for younger adults?
14. Other than the particular exercise instructions what other information should be included for fall prevention?
15. What would be the appropriate tone when creating exercise instructions for elderly demographic? (Serious, humorous?)

Occupational Therapist:

1. How long has your experience been as an Occupational Therapist?
2. How long have you been working with senior clients?
3. What are the specific physical issues you focus on working with the seniors?
4. What motivates adults in the 60-70 age group to seek an exercise routine?
5. What sort of experience have you had with people in the 60-70 age range, who have not previously had a fall, regarding concerns about falling as they go about their daily activities? (such as using stairs)
6. Amongst the falls you have treated, what is the most common trigger for a fall? In these cases do you find that having had a fall motivates people to change their attitudes towards exercise? If so, how?
7. What form of information and exercise instructions do you provide to your clients?
8. What particular exercises are best for fall prevention?

9. How often should each set of exercise be repeated in a week in order to receive a positive outcome in regards to reducing and preventing falls?
  
10. Can you refer me to existing exercise programs that are geared towards fall prevention?
  
11. What is your opinion about home-based exercise vs. group exercise for elderly?
  
12. What methods do you use to encourage your clients to follow up with the recommended exercises? Can you give examples?
  
13. Can you give an example of a case that a client didn't follow-up with their exercise routine and if you helped them achieve their goal by staying motivated to do their routine on their own? How?
  
14. What do you think is the most important element to encourage elderly to take part in an exercise routine?
  
15. What would be the appropriate tone when creating exercise instructions for elderly demographic? (Serious, humorous?)

## APPENDIX C

## Informed Consent Form



The purpose of an informed consent is to ensure that you understand the purpose of the study and the nature of your involvement. The informed consent has to provide sufficient information such that you have the opportunity to determine whether you wish to participate in the study.

**Study Title:** Fall Prevention Exercise Toolkit

**Study Personnel:** The following personnel are involved in this research project and may be contacted at any time: Yasaman Shamloo (principal researcher) [yasaman\\_shamloo@carleton.ca](mailto:yasaman_shamloo@carleton.ca) [REDACTED], Dr. AviParush (Psychology Faculty Advisor) [avi\\_parush@carleton.ca](mailto:avi_parush@carleton.ca) 613-520-2600 ext. 6026, Professor Lois Frankel (Industrial Design Faculty Advisor) [Lois\\_Frankel@carleton.ca](mailto:Lois_Frankel@carleton.ca) 613-520-5675

If you have any ethical concerns about this study, please contact Dr. Chris Davis (Associate Chair, Research Ethics Board for psychological research) [chris\\_davis@carleton.ca](mailto:chris_davis@carleton.ca) 613-520-2600, ext. 2251 & Professor Thomas Garvey (Director, School of Industrial Design) [thomas\\_garvey@carleton.ca](mailto:thomas_garvey@carleton.ca) 613-520-5674

**Purpose and Task Requirements:** You are asked to take part in an interview to help us gain knowledge about the correct style of fall prevention exercise and the needed repetition to have positive outcome. The information gained from the interview will help us develop recommendations for design elements to create exercise instructions that bring enthusiasm back to individuals in order for them to exercise as a life habit and to prevent future stair falls.

**Potential Risk and Benefit:** There are no physical or psychological risks in this study. If you feel anxious and/or uncomfortable in any way about your involvement in this study, please bring your concerns to the researcher's attention. The benefits of this participation are, your contribution to a design for better instructions to do preventative physical exercises that mitigate the harms of falling. **Anonymity/Confidentiality:** The data collected in this interview are confidential. All data are coded such that your name is not associated with the data. The coded data will only be available to the researchers involved in this study. The electronic data will be stored in a secure external hard drive for approximately two years. With your permission, I would like to audio record the interview. **Right to Withdraw:** Your participation in this study is entirely voluntary. At any point during the study, you have the right to not answer certain questions or to withdraw with no penalty whatsoever.

I have read the above description of "Fall Prevention Exercise Toolkit" and understand the conditions of my participation. My signature indicates that I agree to participate in the interview. This in no way constitutes a waiver of my rights.

Full Name (please print): \_\_\_\_\_

Participant Signature & Date: \_\_\_\_\_

Researcher Signature & Date: \_\_\_\_\_

This study has received clearance by the Carleton University Psychology Research Ethics Board

## Debriefing Form



**Study Title:** Fall Prevention Exercise Toolkit

Thank you for participating in this study. Your time and effort are greatly appreciated!

**Purpose of Study:**

It has been established that by participating in a tolerated home-based exercise program there can be a significant reduction in the risk of falling and number of falls among elderly persons.

Regardless of the benefits of exercise, due to lack of enthusiasm older adults experience the lowest levels of physical activity of all age groups. While recent recommendations suggest that older adults should develop exercise plans and goals with their physician little is known about the availability of experts to create these plans and make them available to the elderly demographic. It is believed that older adults' self-efficacy beliefs (belief in one's ability to perform a specific behaviour in order to attain a desired result) are modifiable and can be influenced by assistance in developing achievable outcome goals.

This research examines the relationship between self-efficacy beliefs (belief in one's ability to perform a specific behaviour in order to attain a desired result) and the willingness to attend home-based exercise session. We have asked you to participate in this interview so we can use your insight and knowledge to create recommendations for designers to create fall prevention

exercise instructions. We are interested in learning if design can contribute to encouragement for regular exercise and physical activity to prevent future stair falls.

Please feel free to contact us if you would like to discuss any aspect of the research. The following people are involved in this study:

Yasaman Shamloo (principal researcher) yasaman\_shamloo@carleton.ca [REDACTED]

Dr. AviParush (Psychology Faculty Advisor) avi\_parush@carleton.ca 613-520-2600 ext. 6026

Professor Lois Frankel (Industrial Design Faculty Advisor) Lois\_Frankel@carleton.ca 613-520-5675. If you have any ethical concerns about this study, please contact:

Professor Thomas Garvey (Director, School of Industrial Design) thomas\_garvey@carleton.ca 613-520-5674

Dr. Chris Davis (Associate Chair, Research Ethics Board for psychological research)  
[chris\\_davis@carleton.ca](mailto:chris_davis@carleton.ca) 613-520-2600, ext. 2251

*Interested in finding out more about Fall Prevention Exercise and effects of personal behaviour?*

*Check out these websites:*

*Fall Prevention Exercises:*

*<http://www.seniorabilitiesunlimited.com/fallprevention/fallpreventionexercises.html>*

*Can exercise prevent falls? <http://www.eldergym.com/elderly-balance.html>*

This study has received clearance by the Carleton University Psychology Research Ethics Board

## APPENDIX D

### External Rater Table-Interview With Experts

Researcher	Rater #1	Rater #2	Matches	Reference
1. Focus For Exercise	1. Tailored for needs	1. Injury		2. <i>Motivation</i> : "getting better or feeling better or getting more out of life"
2. <b>Motivation</b>	2. <b>Motivation</b>	2. <b>Motivation</b>	X	3. <i>Concern/Safety/Wellbeing</i> : "For that very reason, to prevent falls" / "This demographic doesn't need their heart racing" / "They are here to improve their lives and get healthier and fitter"
3. <b>Senior Concerns</b>	3. <b>Need for wellbeing</b>	3. <b>Safety</b>	X	7. <i>Convenience</i> : "At home if they have the fitness balls, they can set on that when watch TV, all while you are mindlessly watching the TV."
4. Instructions	6. Follow up	4. Feelings		8. <i>Time/Repetition</i> : "Ideally if you do it every other day, 2-3 times a week. The duration depends on the ability of each individual, maybe 10 repetitions of each move"
5. Young vs Old	7. Challenge			
6. Fall Prevention Exercise	8. Comprehension			
7. <b>Home Based</b>	4. <b>Accessibility</b> 5. <b>Convenience</b>		X X	
8. <b>Repetition</b>	9. <b>Time</b>		X	
9. Info in booklet				
10. Tone				
			<b>Matches:</b> (5/10) 50%	

### INTERVIEW WITH EXERCISE LEADERS (Interpreted Phrases)

## Appendix E

### User Interview Questions

1. Please introduce your self, your age and previous occupation? Have you experienced a fall before?
2. How do you feel after you have finished your exercise session? What specifically makes you feel this way?
3. How do you usually prepare yourself before you attend a session? How do you motivate yourself to attend each class?
4. Why have you chosen to do this class and this type of exercise?
5. How often do you attend these sessions? If you miss a day, what likely would be the reason?
6. Do you have some one that attends the classes with you? (a friend or family member?)
7. What exercises do you like best? Can you explain why?
8. What exercises do you like least? Can you explain why?
9. What particular exercise is most challenging for you? Why?

10. Do you do any of these exercises at home on your own? Why or Why not? If so, which ones?
11. When doing the exercises, do you prefer silence, to hear the instructions, or perhaps music? Why? If you like music with your exercises, what type of music or sound track do you prefer while exercising?
12. What do you think about the instructions given by the instructor? (For example the style and clarity, the flow and structure)
13. How do you feel exercising in a group fitness class?
14. What do you think about the noise and crowdedness of the class? Does this distract you?
15. Have you considered a personal trainer? Why?

## Appendix F

## Informed Consent Form



The purpose of an informed consent is to ensure that you understand the purpose of the study and the nature of your involvement. The informed consent has to provide sufficient information such that you have the opportunity to determine whether you wish to participate in the study.

**Study Title:** Fall Prevention Exercise Toolkit

**Study Personnel:** The following personnel are involved in this research project and may be contacted at any time: Yasaman Shamloo (principal researcher) [yasaman\\_shamloo@carleton.ca](mailto:yasaman_shamloo@carleton.ca)

██████████ Dr. AviParush (Psychology Faculty Advisor) [avi\\_parush@carleton.ca](mailto:avi_parush@carleton.ca) 613-520-2600 ext. 6026, Professor Lois Frankel (Industrial Design Faculty Advisor)

[Lois\\_Frankel@carleton.ca](mailto:Lois_Frankel@carleton.ca) 613-520-5675

If you have any ethical concerns about this study, please contact Dr. Chris Davis (Associate Chair, Research Ethics Board for psychological research) [chris\\_davis@carleton.ca](mailto:chris_davis@carleton.ca) 613-520-2600, ext. 2251 & Professor Thomas Garvey (Director, School of Industrial Design)

[thomas\\_garvey@carleton.ca](mailto:thomas_garvey@carleton.ca) 613-520-5674

**Purpose and Task Requirements:** The purpose of this study is to understand and have knowledge about the feeling and emotions of individuals after exercise session. The information

gained from the interview will help us develop recommendations for design elements to create exercise instructions that bring enthusiasm back to individuals in order for them to exercise as a life habit.

**Potential Risk and Benefit:** There are no physical or psychological risks in this study. If you feel anxious and/or uncomfortable in any way about your involvement in this study, please bring your concerns to the researcher's attention. The benefits of this participation are, your contribution to a design for better instructions to do preventative physical exercises that mitigate the harms of falling. And you will also receive a \$10 gift certificate for your participation.

**Anonymity/Confidentiality:** The data collected in this interview are confidential. All data are coded such that your name is not associated with the data. The coded data will only be available to the researchers involved in this study. The electronic data will be stored in a secure external hard drive for approximately two years. With your permission, I would like to audio record the interview.

**Right to Withdraw:** Your participation in this study is entirely voluntary. At any point during the study, you have the right to not answer certain questions or to withdraw with no penalty whatsoever.

I have read the above description of "Fall Prevention Exercise Toolkit" and understand the conditions of my participation. My signature indicates that I agree to participate in the interview. This in no way constitutes a waiver of my rights.

Full Name (please print): \_\_\_\_\_

Participant Signature & Date: \_\_\_\_\_

Researcher Signature & Date: \_\_\_\_\_

This study has received clearance by the Carleton University Psychology Research Ethics Board

### Debriefing Form



**Study Title:** Fall Prevention Exercise Toolkit

Thank you for participating in this study. Your time and effort are greatly appreciated!

**Purpose of Study:**

It has been established that by participating in a tolerated home-based exercise program there can be a significant reduction in the risk of falling and number of falls among elderly persons.

Regardless of the benefits of exercise, due to lack of enthusiasm older adults experience the lowest levels of physical activity of all age groups. While recent recommendations suggest that

older adults should develop exercise plans and goals with their physician little is known about the availability of experts to create these plans and make them available to the elderly demographic. It is believed that older adults' self-efficacy beliefs (belief in one's ability to perform a specific behaviour in order to attain a desired result) are modifiable and can be influenced by assistance in developing achievable outcome goals.

This research examines the relationship between personal behaviour and exercise routine. We have asked you to participate in this interview right after your exercise session to see how you feel right after a session, what makes you feel this way and what is your encouragement to attend the session. The information you have provided will be pooled with similar information obtained from other participants. All the data will be analyzed together and used to further our understanding if design can contribute to encouragement for regular exercise and physical activity to prevent future stair falls.

Please feel free to contact us if you would like to discuss any aspect of the research. The following people are involved in this study:

Yasaman Shamloo (principal researcher) yasaman\_shamloo@carleton.ca 

Dr. AviParush (Psychology Faculty Advisor) avi\_parush@carleton.ca 613-520-2600 ext. 6026

Professor Lois Frankel (Industrial Design Faculty Advisor) Lois\_Frankel@carleton.ca 613-520-5675

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613-520-5674

Dr. Chris Davis (Associate Chair, Research Ethics Board for psychological research)

[chris\\_davis@carleton.ca](mailto:chris_davis@carleton.ca) 613-520-2600, ext. 2251

*Interested in finding out more about Fall Prevention Exercise and effects of personal behaviour*

*r? Check out these websites:*

Effect of exercise on balance: <http://www.medscape.com/viewarticle/729469>

Home based exercise improves muscle strength:

<http://www.universaldrugstore.com/news/osteoporosis/home-based-exercise-improves-muscle-strength-qol-in-osteoporotic-elderly/>

This study has received clearance by the Carleton University Psychology Research Ethics Board

Appendix G

External Rater Table-User Interviews

Researcher	Rater #1	Rater #2	Matches	Reference
<ol style="list-style-type: none"> <li>1. <b>Feeling</b> After Session</li> <li>2. <b>Fall Experience</b></li> <li>3. <b>Motivation</b></li> <li>4. <b>Choice of Class</b></li> <li>5. <b>Likes/Dislike Moves</b></li> <li>6. <b>Music</b></li> <li>7. Exercise Repetition</li> <li>8. <b>Personal Trainer</b></li> <li>9. Companionship</li> <li>10. Home Based</li> <li>11. Group Vs. Individual</li> </ol>	<ol style="list-style-type: none"> <li>1. Better than usual <b>feeling</b></li> <li>2. Need for wellbeing</li> <li>3. <b>Motivation</b></li> <li>4. <b>Accessibility,</b></li> <li>5. <b>Convenience</b></li> <li>6. <b>Challenge</b></li> <li>7. <b>Ambiance</b></li> <li>8. Comprehension</li> <li>9. <b>Affordability</b></li> <li>10. Proof of improvement</li> </ol>	<ol style="list-style-type: none"> <li>1. <b>Feelings</b></li> <li>2. <b>Injury</b></li> <li>3. <b>Motivation</b></li> <li>4. Health</li> <li>5. <b>Cost</b></li> <li>6. Health-conscious</li> </ol>	<p><b>X</b></p> <p><b>X</b></p> <p><b>X</b></p> <p><b>X</b></p> <p><b>X</b></p> <p><b>X</b></p> <p><b>X</b></p>	<ol style="list-style-type: none"> <li>1. <i>Feeling</i>: "I like exercising and I like the class"</li> <li>2. <i>Injury</i>: "I tripped and fell on my shoulder"</li> <li>3. <i>Motivation</i>: "I tripped and fell on my shoulder"</li> <li>4. <i>Convenience</i>: "it is easier to come here since it is easier for me to come here"/</li> <li>"Especially the weights and the bands, since I already have those at home"</li> <li>5. <i>Challenge/like</i>: "The wall ones, because I like them because it makes me challenge myself"</li> <li>6. <i>Music/Ambiance</i>: "but I like the music in the back-ground"</li> <li>8. <i>Cost/Trainer/Affordability</i>: "Personal trainer, not really, the expenses are too much"</li> </ol>
			<b>Matches:</b> (8/11) 73%	

INTERVIEW WITH SENIORS AFTER A EXERCISE SESSION (Interpreted Phrases)

Appendix H

Diary Keeping Instruction Sheet

### 6 Easy Steps to Start Your Daily Diary

**1** Go to [www.penzu.com](http://www.penzu.com)

**2** Enter provided username & password

**3** Click

**4** Choose this option to view all entries

**5** Choose the current date

**6** Enter your daily activities

JANUARY 12, 2013	
Year of entry:	2013
Month of entry:	January
Day of entry:	12
Year of entry:	2013
Month of entry:	January
Day of entry:	12
Year of entry:	2013
Month of entry:	January
Day of entry:	12
Year of entry:	2013
Month of entry:	January
Day of entry:	12
Year of entry:	2013
Month of entry:	January
Day of entry:	12

## Appendix I

### Artifact Analysis Diagram

CATEGORIES/CODE	TITLE	COMMENTS
<b>ARTIFACTS</b> 1. Image 2. Typography 3. Color vs. B&W 4. Tone 5. Style 6. Other Info	<b>I.</b> Exercise calendar	<b>I.</b> Sketches <b>2.</b> San-Serif, text heavy <b>3.</b> Mono tone (Blue-Black) <b>4.</b> Serious <b>5.</b> Coil calender
	<b>J.</b> Human Kinetics	<b>6.</b> Calorie count, tracking progress, diet and nutrition
	<b>K.</b> Able Bodies Balance	
	<b>L.</b> Fall Proof	
	<b>M.</b> Instructor hand out	<b>J.</b> Photo <b>2.</b> Serif, text heavy <b>3.</b> B&W
	<b>N.</b> Instructor hand out	<b>4.</b> Very informative <b>5.</b> Book, saddle stitch
	<b>O.</b> Aging Activity leaflet	<b>6.</b> Benefits, the reason why you should do them
		<b>K.</b> Sketches <b>2.</b> Serif, text heavy, Barley any images <b>3.</b> B&W
		<b>4.</b> Educational/Serious <b>5.</b> Book, saddle stich
		<b>6.</b> Body anatomy
	<b>L.</b> Photo and Video <b>2.</b> Serif <b>3.</b> Color	
	<b>4.</b> Educational and light <b>5.</b> Book and video	
	<b>M.</b> Computer generated sketches <b>2.</b> san-serif type <b>3.</b> B&W <b>4.</b> Serious, informative	
	<b>5.</b> Loose sheets	
	<b>N.</b> Hand drawn sketches <b>2.</b> Handwriting <b>3.</b> B&W <b>4.</b> Serious <b>5.</b> Loose sheets	
	<b>O.</b> Photo <b>2.</b> Serif <b>3.</b> Color <b>4.</b> Serious	
	<b>5.</b> Accordion fold <b>6.</b> Information about falls and how to seek help	

CATEGORIES/CODE	TITLE	COMMENTS
<b>ARTIFACTS</b> 1. Image 2. Typography 3. Color vs. B&W 4. Tone 5. Style 6. Other Info	<b>A.</b> The Yoga Deck	<b>A.</b> Simplified sketches <b>2.</b> San-Serif font <b>3.</b> Mono tone (beige and brown) <b>4.</b> Serious, informative.
	<b>B.</b> Chair Exercises For Older Adults	<b>5.</b> Cards
	<b>C.</b> Elder gym e-book Fall Prevention	
	<b>D.</b> Yoga Your Home Practice Companion	<b>B.</b> Sketches <b>2.</b> Serif type, more text than image <b>3.</b> B&W <b>4.</b> Serious and informative <b>5.</b> PDF
	<b>E.</b> Home based Yoga	<b>C.</b> Pixilated Photography <b>2.</b> Serif-text heavy
	<b>F.</b> Reiki Card Deck	<b>3.</b> color <b>4.</b> Serious <b>5.</b> E-book <b>6.</b> Complete fall prevention info
	<b>G.</b> Exercise ball	<b>D.</b> Clear Photography <b>2.</b> San-Serif even amount of text and image. <b>3.</b> Color
	<b>H.</b> Total Body Blast	<b>4.</b> Friendly and serious <b>5.</b> Book, saddle stitch <b>6.</b> Diet info, environment to do exercise in
		<b>E.</b> Photography <b>2.</b> San-serif <b>3.</b> Color
		<b>4.</b> Easy going and fun <b>5.</b> Coil bind <b>6.</b> Nutrition
	<b>F.</b> Photography, minimal text <b>2.</b> San-serif	
	<b>3.</b> Color <b>4.</b> Relaxing and soothing <b>5.</b> Cards	
	<b>G.</b> Photography <b>2.</b> San-serif <b>3.</b> Color <b>4.</b> Serious	
	<b>5.</b> Book, saddle stitch	
	<b>H.</b> Photo <b>2.</b> San-Serif <b>3.</b> B&W <b>4.</b> Serious	
	<b>5.</b> Book, saddle stich	

Appendix J

WebSort Instruction Sheet

**WEBSORT INSTRUCTIONS**

**1**



From the right side of screen  
drag and drop images into groups

**2**



Leave comment about  
your preference here

Click on the top  
part of each group

**3**



Type in the name of each  
category and your preference  
number here

## Appendix K

### Prototype Evaluation Questionnaire

This is an example of question 1&2, the rest of the questions (3-12) follow the same format.

**Study Title: Fall Prevention Exercise Toolkit**

**Name / Last Name:**.....

You will be provided with exercise instruction artifacts in pairs, please take your time to view and interact with each one separately.

After you have carefully viewed each item, rate each one separately according to the category. Answer the two final questions taking both items in mind.

After answering the questions, write down which item you visually prefer and why.

Thank you very much for your time & participation!

<b>1 &amp; 2</b>	<b>Visual appearance:</b>	<b>Which design do you prefer?</b>
1	Ugly 1 2 3 4 5 6 7 Beautiful	<b>1 or 2</b>
2	Ugly 1 2 3 4 5 6 7 Beautiful	<b>Why?</b>
	<b>Comprehension:</b> (text, size, etc.)	
1	Difficult to read 1 2 3 4 5 6 7 Easy to read	
2	Difficult to read 1 2 3 4 5 6 7 Easy to read	
	<b>Following the visuals:</b> [can you do the exercise right now? Successful: <b>Yes No</b>	
1	Could not follow 1 2 3 4 5 6 7 Easy to follow	<b>Over all, what would you rate your preferred design from a scale of 1 to 10, 10 being your most favorite?</b>
2	Could not follow 1 2 3 4 5 6 7 Easy to follow	
	<b>Level of motivation towards exercise move:</b>	
1	What's motivation? 1 2 3 4 5 6 7 I'm pumped	<b>Comments:</b>
1	What's motivation? 1 2 3 4 5 6 7 I'm pumped	
	<b>1. What is the first thought that comes to mind when interacting with this design?</b>	
	.....	
	<b>2. Would you consider doing the activity explained on the card/booklet? Why?</b>	
	.....	

## Appendix L

## Prototype Evaluation Coding

CATEGORIES/CODE	RESPONSE/QUOTES	RESEARCHERS COMMENTS	
<b>PROTOTYPE EVALUATION</b>	<b>2. Environment</b>	<b>2.</b> The environmental cues help the participant to situate themselves better to follow the exercise move, that can be an important point for guiding them to correctly follow the instructions.	
	1. Figure	 <p>It would have been easier if there were a <b>wall</b> Not having a wall made it unclear Seeing the elevator background is nice, <b>it situates me more</b></p>	Not having a specific environment and area to do each exercise is important as well to the participant, this gives an opportunity for the participant to choose their own scenario, <i>the instructions becomes a guide line for good health here.</i>
	<b>2.Environment</b>	 <p>For sure, doesn't <b>require special place</b> or equipment, <b>you can do them anywhere.</b> The <b>simplified image of the T. V.</b> adds a positive feeling, I can relate to that</p>	<b>3.</b> Knowing about the benefits becomes a motivation factor to follow-up with the exercise.
	<b>3.Benefit</b>	<b>3. Benefit / Awareness</b>	The awareness makes the task more appealing to do and follow. <i>(The element of delight and pleasure)</i>
4.Format	 <p>I would, its because you are <b>aware of the value</b></p>	If the participant doesn't know what they are getting out of it they are less likely to do the task.	
5.Time	<ul style="list-style-type: none"> <li>• Yes, keeping fit can help me <b>live longer</b></li> <li>• Yes, I know it well <b>help me keep in shape</b></li> <li>• Yes I would, value in toning muscles</li> <li>• Yes, <b>maybe if I knew why I would be more motivated</b></li> <li>• Helps toning my legs</li> <li>• This card makes me more aware of my health, so I like it</li> </ul>		
6.Motivation	 <p>Maybe <b>add benefits</b> Its nice to see the <b>reason why I should do the move and what I get out of it</b> Knowing about the <b>benefits makes me want to do the exercise</b></p>		
7.Composition <ul style="list-style-type: none"> <li>• Readability</li> <li>• Ability to Follow</li> </ul>	<ul style="list-style-type: none"> <li>• I wish this had the benefit section like the last card</li> <li>• yes, very good for my health</li> <li>• there should be a benefit sections</li> </ul>		

# Appendix M

## Ethics Approval Form

Carleton University  
Psychology Research Ethics Board

### Certificate of Ethics Clearance

Principal Investigator: **Avi Parush**      Department: **Psychology**      StudyNumber: **12-194**

Institution(s) where research will be conducted:  
**Carleton University, Senior Citizens centers**

Co-Investigators and other researchers:

Researcher	Study Role	Position
Avi Parush	Faculty Sponsor	Faculty

Study Title: **Fall Prevention Exercise Toolkit**

Approval Date: **02/22/2013**      Validity Term: **1 Until Aug 31st Next**      Approval Type: **Final**

Submitted Date	Study Component	Approval Date
02/22/2013	Addendum	02/22/2013
01/22/2013	Addendum	01/23/2013

Comments:

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**Certification**

The protocol describing the above-named project has been reviewed by Carleton University Psychology Research Ethics Board and the research procedures were found to be acceptable on ethical grounds for research involving human participants.

  
\_\_\_\_\_  
Chair, Ethics Committee for Psychology Research

This Certificate of Clearance is valid for the above term provided there is no change in the research procedures.