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Dated: 03/29/2018

**PREVENTIVE BEHAVIORS FOR COGNITIVE HEALTH MAINTENANCE:  
UNDERSTANDING THE ROLE OF MESSAGE FRAMING AND  
INVOLVEMENT**

By

**RUTA V. SAWANT**

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**PREVENTIVE BEHAVIORS FOR COGNITIVE HEALTH MAINTENANCE:  
UNDERSTANDING THE ROLE OF MESSAGE FRAMING AND INVOLVEMENT**

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## ABSTRACT

**Introduction:** Neurocognitive conditions like Alzheimer's disease, associated with decline in cognitive functioning and progression to loss of mental and physical functioning are on the rise due to lack of available treatment and increasing proportion of aging population. There are 5.3 million Americans currently with Alzheimer's disease and the number is expected to rise to 1.1. trillion by 2050 with equally exponential rise in costs, morbidity and mortality. In such times, efforts are being made by national organizations such as National Institute of Health and CDC to increase awareness of early identification and engagement in behaviors which preserve cognitive functions. Such efforts have highlighted the importance of effective communication in disseminating information about cognitive health. Communications need to address the prevailing concerns of the target older adult population and encourage them to engage in preventive behaviors for maintenance of cognitive health. Psychosocial research in communication has depicted that the manner in which the information about preventive behaviors can influence the perceptions, judgements, decisions and behaviors. At the same time, individual characteristics like the involvement (e.g., personal relevance) can affect the predisposition towards a behavior. The current study therefore aimed at evaluating the effect of message framing and involvement on intention to engage in preventive behaviors.

**Methods:** The study was an experimental, cross-sectional factorial survey design consisting of two factors each with two levels: (a) Message-framing (positive-framing and negative-framing) and (b) Involvement (Low and High). Protection motivation theory of fear appeals was used to develop a conceptual model. The proposed model was

developed measured the association between the manipulated factors levels of message-framing and involvement on constructs of PMT namely perceived severity, perceived vulnerability, response-efficacy, self-efficacy and intention to engage in recommended preventive behaviors. Vignettes were developed for each level of message-framing and involvement scenarios were constructed. The PMT questionnaire was developed using pre-validated questionnaires and adapting them to the current study. All PMT variables were measured on a 7-point Likert scale. The survey was developed in an online data collection survey software Qualtrics and was disseminated online. Reliability analysis, descriptive statistics, ANCOVA and multiple linear regression were performed using SAS® version 9.2 at a priori significance level of 0.05. Comprehensive model testing was conducted using structural equation modeling (SEM) technique. Mplus was used to test the model.

**Results:** A total of 368 completed surveys were obtained. Multiple linear regression analyses indicated that involvement had a significant positive association with perceived severity ( $p=0.0478$ ), perceived vulnerability ( $p=0.0318$ ) and intention ( $p=0.0001$ ). Message framing had a significant positive association with perceived severity ( $p=0.0041$ ) and perceived vulnerability ( $p=0.0007$ ) but a negative association with self-efficacy ( $p=0.002$ ). There was no effect of message-framing and involvement on response-efficacy. Message-framing also did not have a direct effect on intention. However, path analysis indicated that message-framing had an indirect negative effect on intention. Perceived severity, perceived vulnerability, response-efficacy and self-efficacy were all significantly associated with increased intention to engage in preventive behaviors.

**Conclusion/Implications:** The study results indicated that higher level of involvement (i.e. personal relevance) has a positive effect on PMT constructs towards improving engagement in preventive behaviors. At the same time, although message-framing had a positive effect on perceived severity and vulnerability, it had a negative effect on self-efficacy and a negative overall indirect effect on intention. The results highlight the importance of increasing awareness about personal risk factors for Alzheimer's disease and using appropriate message-framing structures in developing materials to improve engagement in preventive behaviors for cognitive health. Healthcare professionals and organizations may take these findings into consideration to develop future studies and communication material.

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*Dedicated to*

*My Parents (SHUBHANGI SAWANT and VIJAY SAWANT)*

*and*

*my Brother (GAURAV SAWANT)*



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## **CHAPTER 1 INTRODUCTION**

### **Cognitive Health**

There is no clear consensus among the scientific community with respect to the exact definition of cognitive health (Hendrie et al., 2006). However according to the experts in the field, cognitive functioning consists of the components of language, thought, memory, executive function, judgment, attention, perception, remembered skills, and ability to live a purposeful life (Anderson, Day, Beard, Reed, and Wu, 2009; National Research Council, 2000). Cognitive health corresponds to physical health in terms of the continuum along which their performance can be evaluated. A healthy cognitive functioning adult is one who can perform the above-mentioned functions without any difficulty. As the individual ages, certain components of the cognitive function begin to decline and move along the continuum from mild cognitive impairment to severe states such as Alzheimer's disease or other forms of dementia (Insel, Landis, and Collins, 2013). Although, it is essential to understand that some people may not develop serious cognitive impairment throughout their lifetime and people with mild cognitive impairment may not necessarily develop dementia. There are several causative and mediating factors, which determine the course for the disease, and these factors vary from one person to another. Regardless of how one develops cognitive impairment, the consequences of decline in cognitive health can have profound implications on the person's physical, mental and social functioning. Most commonly, cognitive impairment is experienced by older adults. In addition to the gradual decline in physical functioning

with old age, deterioration of cognitive health further reduces their ability to perform daily functions effectively. As cognitive impairment increases in severity, individuals are unable to care for themselves such as preparing meals and managing finances. Often, individuals with cognitive decline experience difficulty in managing their medications and other existing medical conditions.

### **Cognitive Impairment as a Public Health Concern**

Cognitive impairment or mild cognitive impairment, in many cases, is the initial stage towards development of Alzheimer's disease or other form of dementia. Dementia is a collective term that describes a wide range of symptoms associated with decline in mental ability severe enough to interfere with daily life. A study by National Institute on Aging estimated that 13.9% of American adults over age 70 have some form of dementia, Alzheimer's disease being the most common cause (Plassman et al., 2007). Alzheimer's disease is a progressive neurodegenerative disorder, which is characterized by deterioration of selective cognitive domains, specifically those related to memory. Alzheimer's disease [AD] was first described in 1906 by Dr. Alois Alzheimer in one of his patients who experienced memory loss, paranoia and psychological changes. Since then, research efforts over the years have tried to understand this complex disease. Only after about 70 years later, Alzheimer's disease was identified as the most common cause of dementia (Alzheimer's Association, 2016). Approximately 60 to 80 percent of dementia cases are due to Alzheimer's disease. Dementia has emerged as a high priority issue due to the growing aging population and the absence of effective treatment (Norton, Matthews, Barnes, Yaffe, and Brayne, 2014). However, in practice, recognition is often delayed until a behavioral crisis has occurred, and physicians rely on families to bring



their attention to a cognitive problem (Boise, Neal, and Kaye, 2004). At the same time, due to the increased life-span as a result of medical advancement and the baby-boomer generation reaching the ages of 65 years and older, the proportion of older adults is on the rise (Alzheimer's Association, 2017). More the aging population, more the prevalence of cognitive impairment and associated healthcare burden. It is estimated that by 2030, approximately 74 million Americans (i.e. 20 percent of the U.S. population) will consist of those aged 65 (up from 14 percent in 2012) (Alzheimer's Association, 2017). In 2017, 5.3 million Americans aged 65 years and older had Alzheimer's disease (Hebert, Weuve, Scherr, and Evans, 2013). This number is expected to reach 7.1 million by 2025 and to 13.8 billion (triple from 2017 estimates) by 2050. Alzheimer's was reported to be the 6<sup>th</sup> leading cause of death and 5<sup>th</sup> among adults 65-85 years of age (Xu, Kochanek, Murphy, and Tejada-Vera, 2010). People with Alzheimer's disease live through years of morbidity with the progression of the disease before they die (Ives, Samuel, Psaty, and Kuller, 2009). As a result, many individuals with Alzheimer's die due to other comorbid complications such as pneumonia, leading to the under-reporting of Alzheimer's as the underlying cause of death (Romero, Benito-León, Louis, and Bermejo-Pareja, 2014; Romero, Benito-León, Mitchell, Trincado, and Bermejo-Pareja, 2014). Corresponding to the severity of cognitive disorders are the costs associated with them. Dementia is one of the costliest conditions to the society (Hurd, Martorell, Delavande, Mullen, and Langa, 2013). In 2017, the total costs of all individuals with Alzheimer's and other dementia were estimated to be \$259 billion (Alzheimer's Association, 2017). The direct expenditures for dementia are higher than cancer and similar to that of heart diseases.

### **Challenges Facing Treatment and Management of Alzheimer's Disease**

### *Lack of effective treatment*

Currently the U.S. Food and Drug Administration (FDA) has approved five medications for the treatment of symptoms of Alzheimer's disease.

**Table 1-1: Food and Drug Administration Approved Drugs for Alzheimer's Disease**

<b>Drug name</b>	<b>Brand name</b>	<b>Approved For</b>	<b>FDA Approved</b>
1. donepezil	Aricept	All stages	1996
2. galantamine	Razadyne	Mild to moderate	2001
3. memantine	Namenda	Moderate to severe	2003
4. rivastigmine	Exelon	All stages	2000
5. donepezil and memantine	Namzaric	Moderate to severe	2014

These drugs are primarily used to relieve symptoms of AD and other dementia, but have been found to produce discouragingly small effects resulting in discontinuation of the treatments. A study on persistence in anti-dementia medications reported that more than 3 out of 4 patients discontinued the drugs within one year of treatment initiation (Ahn et al., 2015). Along with limited efficacy, the five approved drugs have often been claimed as not cost-effective by critics in the field (Casey, Antimisiaris, and O'Brien, 2010). None of these available treatments can slow or stop the destruction of neurons that causes Alzheimer's disease. Several attempts have been made in the last decade towards the development of treatments which can alter the underlying disease pathology, called as Disease Modifying Treatments or DMTs. However, none of these treatment strategies have yet been successful. In the decade of 2002-2014, overall 244 drug compounds were tested in clinical trials registered with clinicaltrials.gov (a National Institutes of Health registry of publicly and privately funded clinical studies), only one was approved. Drug candidates in Alzheimer's disease have been reported to have the highest failure rates that

of any disease area (99.6% for AD compared to 81% for cancer)(Cummings, Morstorf, and Zhong, 2014). Among DMTs, there were about 47 agents in Phase II and Phase III development stages, however many of these agents have failed to meet the endpoints resulting in termination of the clinical trials. Despite of ongoing efforts, the discouraging performance of the candidates and lack of any effective treatment thereafter, has often served as a barrier in diagnosis and management of Alzheimer's disease, by patients as well as by physicians (Bradford, Kunik, Schulz, Williams, and Singh, 2009).

### **Missed and Delayed Diagnosis and Lack of Public Awareness.**

A study by Bradford and colleagues reviewed the literature for problems facing the world of dementia and Alzheimer's in its timely diagnosis and treatment initiation (Bradford et al., 2009). The authors reported several contributing factors for missed and delayed diagnoses of dementia in primary care settings. Patient-, provider-, caregiver- and system-related barriers were identified among which the major contributory factors included problems with attitudes and patient-provider communication, educational deficits, and system resource constraints. Among the patient factors, a common barrier to timely diagnosis was patients' refusal to be assessed or treated if diagnoses. A possible reason for patients' unwillingness was identified to be the distress associated with the diagnosis of a condition which has no cure. At the same time, the assumption that cognitive changes are a normal part of aging rather than the manifestation of a pathological condition indicated a lack of awareness among patients as well as caregivers. As a result, cognitive impairment is widely known to be under-recognized and under-treated in primary care settings (Borson, Scanlan, Watanabe, Tu, and Lessig, 2006). In order to improve vigilance and identification of Alzheimer's disease and other

dementia, education of providers as well as patients is needed. Patients need to be proactive and aware of their own cognitive health status, be vigilant of any unnatural changes and communicate with their providers regarding their observations and concerns of self. Educational efforts that increase the public's understanding of disease or its symptoms and the reduce stigma/fear/shame of the disease are essential to mitigate the overall damaging life-impact of Alzheimer's and other dementia.

### **Primary Prevention against Cognitive Impairment**

The prevention and treatment of cognitive impairment has assumed increasing importance in the light of absence of effective curative treatment. Since neurodegeneration is almost impossible to reverse, the implementation of preventive measures among cognitively healthy individuals offers the best hope against diminishing the harmful impact of cognitive impairment. Among primary prevention strategies, a large body of literature exists on management of modifiable risk factors. A number of risk factors of cognitive impairment can be managed and controlled to reduce their influence on progression of cognitive decline (Andrade and Radhakrishnan, 2009). These include smoking, hypertension, high homocysteine levels, type 2 diabetes, insulin resistance, hypercholesterolemia, and obesity. Along with these risk factors, certain pro-cognitive attributes such as higher education, physical exercise, and mental exercise have been established by research as essential factors in maintaining healthy cognitive function. Management of the modifiable risk factors and the pro-cognitive attributes together consist of preventive behaviors against cognitive impairment. However, it may be particularly challenging in advocating these behaviors among cognitively healthy older adults. The older adults with intact cognitive function may not view cognitive

impairment as an imminent event and therefore may not pay attention to health messages regarding the preventive behaviors. In such instances, simply having knowledge about the benefits of preventive behaviors may not help in translating the beliefs into actions. On the other hand, some older adults may not understand the links between preventive behaviors and their influence on cognition. Also, the consequences of impaired cognitive function may not be realized during the life-years with healthy cognitive function. As a result, promotional messages advocating preventive behaviors may not have a motivational impact on cognitively healthy older adults. These challenges highlight the importance of appropriate health information communication regarding preventive behaviors for the maintenance of cognitive health.

### **Role of Health Information and Health Messages in Promoting Preventive Behaviors**

In medical care, health information is importance as it drives the demand for the care and poorly informed consumers often underestimate the marginal product of medical care. Literature has shown that lower the perceived marginal product less is the likelihood of individuals visiting their physicians (Kenkel, 1990). This is particularly important in the case of preventive care behaviors, where the benefits are not immediately manifested and require long-term commitment for the realization of their marginal product. Poor information communication or lack of knowledge among the target population can add to further challenges in promoting adoption of preventive behaviors. Preventive behaviors have tremendous potential in reducing the disease burden, especially for chronic conditions and among the elderly, since the prevalence of disease conditions is high among this age group (Hsieh and Lin, 1997). Research has demonstrated that more and

better health information increased the probability that the elderly will use preventive care (Hsieh and Lin, 1997).

In the context of cognitive health, there are certain shortcomings with respect to the availability and content of information which is available to the public. According to the focus groups conducted under CDC's Healthy Brain Initiative, very limited information is communicated via the media regarding cognitive health. At the same time, the link between healthy behaviors and cognitive health is not clearly stated. Older adults also reported that the information available through media is confusing, conflicting and possibly impedes their ability to translate what they know to what they should do. In a recent report by Institute of Medicine (IOM) titled 'Cognitive Aging: Progress in Understanding and Opportunities for Action', a review of existing U.S. surveys and studies was conducted to collect information about cognition in older adults (Liverman, Yaffe, and Blazer, 2015). The authors were of the opinion that although researchers are familiar with the information about cognition, it is not presented in formats that are accessible and understandable to the target audience. In order to make information understandable and meaningful, it needs considerable reformatting and requires clear explanation of complex concepts. The authors also reported that one of the biggest challenges in communication of meaningful and useful information is to provide easy-to-understand explanations about relationship between cognitive changes in cognition and their risk of developing MCI or dementia.

These findings serve as essential guidance for the development of effective public health messages for the promotion of healthy behaviors for maintaining cognitive health.

### **Rationale and Research Objective**

The burden of neurological conditions such as Alzheimer's and other forms dementia arising due to cognitive impairment is increasing. The rising proportion of aging population and extension of life-years adds to the complexity of managing of these conditions, making it a public health concern. Although, currently there is no cure for Alzheimer's disease, future treatment and management will heavily depend upon timely diagnoses and patient education and awareness. Information disseminated via various media forms thus plays a primary role in spreading awareness, imparting knowledge and engaging the public in managing their cognitive health. In order that individuals look at maintenance of cognitive health as an important preventive behavior, similar to that as maintaining physical health, understanding of the impact of healthy cognitive function on daily life is essential. People need to understand the consequences of impaired cognitive function on their overall functioning. Knowledge and awareness regarding different types of preventive behaviors and links between these behaviors and cognitive function is essential. Prior research indicated that older adults are not adequately informed regarding these essential preventive behaviors. This study therefore aims at identifying important characteristics of a healthcare message that help in promoting engagement in preventive behaviors against Alzheimer's disease among older adults. The study aims to utilize psychological constructs to understanding how individuals process and react to different types of health messages regarding cognitive health and form perceptions regarding the recommended preventive behaviors. The perceptions thus formed are expected to eventually influence the intention to engage in recommended preventive behaviors. This research would enhance the understanding of how older adults process and form perceptions using the information provided to them. It will help to understand the

message characteristics that are influential in forming perceptions regarding cognitive health and preventive behaviors. The theoretical model used in the study can be further tested in various other information resources and for different groups of patients. The findings from the study can be used to develop effective healthcare messages for public health campaigns, workshops, information leaflets, television advertisements, and other forms of communication media towards promotion of preventive behaviors for cognitive health. The study findings can also be used to develop brief information leaflets (regarding cognitive health maintenance) during primary care physician consultations. Overall, the study can help in development of effective healthcare messages to promote preventive behaviors against cognitive impairment and associated disorders.

**Study objective:**

1. To evaluate the effect the involvement on intention to engage in preventive behaviors for the maintenance of cognitive health.
2. To evaluate the effect of message framing on intention to engage in preventive behaviors for the maintenance of cognitive health.



## **CHAPTER 2**

### **BACKGROUND AND LITERATURE REVIEW**

This chapter discusses the background and literature review pertaining preventive behaviors for cognitive health, public's perceptions about cognitive health and effective health messaging for preventive behaviors.

#### **Preventive Behaviors and Management of Risk Factors towards Maintenance of Cognitive Health**

Dementia, the final stage along the continuum of cognitive impairment, is a growing concern with an estimated prevalence of 47 million worldwide (Baumgart et al., 2015; Martin Prince, Guerchet, and Prina, 2015). The number is expected to triple by 2050 (M Prince, Guerchet, and Prina).

Currently, there is no treatment approach available for the cure of Alzheimer's or other forms of dementia. Cognitive impairment is a progressive and irreversible process, which if not intervened in early stages, can lead to permanent loss of cognitive abilities. Even after treatments become available, primary prevention strategies to reduce the risk of developing cognitive impairment or its progression to severe stages will be essential. Dementia risk reduction is one of the key priorities of the World Dementia Council (WDC), a global advocacy and leadership group to address key dementia challenges (Dementia, 2014). According to Dr. Richard Suzman, Director of the Division of Behavioral and Social Sciences (National Institute of Aging), early preventive interventions such as mental exercises to prevent cognitive decline have enormous potential and will need to be administered along with future drug treatments.

Preventive behaviors are those which either alter the probabilities of illness (risk reduction) or reduce the intensity of consequences associated with the illness (Hsieh and Lin, 1997; Phelps, 1978). In the context of cognitive impairment, Alzheimer's and other dementia, a number of

preventive approaches have been identified as effective risk reduction strategies. These strategies mainly focus on the modifiable risk factors, which can be modified by interventions or individual behaviors. The following sections will briefly discuss some of the key modifiable risk factors. Broadly, modifiable risk factors can be categorized into two types: (a) cardiovascular risk factors and, (b) Lifestyle or behavioral risk factors.

### *Cardiovascular Risk Factors*

Research has demonstrated sufficiently strong evidence for the association of midlife cardiovascular risk factors such as diabetes, obesity, and hypertension have been associated with dementia and Alzheimer's disease (Alzheimer's Association, 2017). Brain health is affected by the health of heart and blood vessels. Brain consumes 20 percent of the body's oxygen and energy supplies. A healthy heart that pumps sufficient oxygenated blood to the brain and blood-vessels that carry this oxygen- and nutrient-rich blood to the heart play an essential role in maintaining brain health. Therefore, factors that pose risk to cardiovascular health also pose risk to the development of cognitive impairment and dementia. These factors include diabetes, obesity in midlife, impaired glucose processing (pre-cursor to diabetes), hypertension, and high cholesterol. The following table summarizes some of the existing research evidence.

- (i) Hypertension: A large body of evidence exists which identifies hypertension as an important and potentially preventable risk factor for cognitive decline and dementia. A systematic review by Etgen and colleagues (Etgen, Sander, Bickel, and Förstl, 2011) reported increased risk of developing cognitive decline and dementia with hazard ratios between 1.24 and 1.49 for hypertension. Studies have reported longitudinal associations between hypertension and cognitive decline (Elias, Goodell, and Dore, 2012; Etgen et al., 2011), and have demonstrated beneficial effects of anti-hypertensive

medications on cognitive functioning (Rouch et al., 2015). Hypertension has been a prevailing concern among the elderly population with prevalence increasing with age. The Framingham Heart Study in men and women free of hypertension at age 55 reported that more than 90% of individuals who are free of hypertension at age 55 will develop it during their remaining lifespan (Levy, Larson, Vasan, Kannel, and Ho, 1996). Age being one of the primary risk factors for cognitive decline, presence of hypertension elevates the existing risk. Moreover, mid-life hypertension has been reported to pose a greater risk as compared to late-life hypertension (Qiu, Winblad, and Fratiglioni, 2005). Hypertension control therefore presents as an important prevention target in a multifactorial approach towards prevention of cognitive-decline (Liverman et al., 2015).

- (ii) **Diabetes Mellitus and Metabolic Syndrome:** Reitz and colleagues conducted a longitudinal community-based study to develop a risk score for prediction of Alzheimer's disease (Reitz et al., 2010). A recent cohort study also reported diabetes as a significant risk factor, with a hazard ratio of 1.81, for transition from mild cognitive impairment to Alzheimer's disease (Xue et al., 2017). The findings demonstrated that diabetes was associated with an increased risk of late-onset Alzheimer's disease. Several other meta-analysis and systematic reviews have established association between diabetes and risk of development or progression to Alzheimer's and other dementia (Biessels, Staekenborg, Brunner, Brayne, and Scheltens, 2006; Hersi et al., 2017; Kloppenborg, van den Berg, Kappelle, and Biessels, 2008; Lu, Lin, and Kuo, 2009; Profenno, Porsteinsson, and Faraone, 2010; Weih, Wiltfang, and Kornhuber, 2007). Diabetes mellitus (Type 2) is assumed to influence cognitive functioning via its

effect on increased peripheral insulin, which in turn affects some of the key biomarkers involved in the development of Alzheimer's disease (Banks, Jaspan, and Kastin, 1997; Park, 2001; Vekrellis et al., 2000). Sufficient evidence exists that managing diabetes can help in reducing the risk of cognitive impairment, Alzheimer's and other dementia and is constantly being advocated in prevention efforts towards maintaining cognitive health.

- (iii) Other cardiovascular risk factors that have been reported to have an influence on the development and progression of cognitive impairment are mid-life obesity (Anstey, Cherbuin, Budge, and Young, 2011; Loef and Walach, 2013; Rönnekaa, Zethelius, Lannfelt, and Kilander, 2011) and hyperlipidemia (elevated cholesterol) (Meng et al., 2014; Solomon, Kivipelto, Wolozin, Zhou, and Whitmer, 2009).

### *Lifestyle Risk Factors*

- (i) Physical Activity and Exercise: Systematic reviews, meta-analyses, prospective longitudinal and cross-sectional studies, as well as randomized control trials have well established the importance of physical activity and exercise on cognitive functioning. These studies have shown that physical activity of any sort (in some cases even mild physical activity) is associated with decreased risk of cognitive impairment and/or improved cognitive function (Ahlskog, Geda, Graff-Radford, and Petersen, 2011; Baumgart et al., 2015; Bherer, Erickson, and Liu-Ambrose, 2013; Blondell, Hammersley-Mather, and Veerman, 2014; Colcombe and Kramer, 2003; Hamer and Chida, 2009; N. T. Lautenschlager et al., 2008; Paterson and Warburton, 2010; Rolland, van Kan, and Vellas, 2008; Smith et al., 2010; Sofi et al., 2011).

There has been a strong consensus regarding the effectiveness of physical activity on improvement of cognitive functioning. Even among inactive but otherwise healthy seniors, initiation of exercise program was found to result in significant improvement in cognitive function (Angevaren, Aufdemkampe, Verhaar, Aleman, and Vanhees, 2008; Barnes et al., 2013). Physical activity and exercise is constantly advocated in various educational and promotional media messages for maintenance of good health. However, physical activity is not often associated with cognitive health in the minds of general public and people are unsure about the way in which the effects of physical activity are manifested onto cognitive functioning. Statistics on the level of physical activity among older adults revealed that only 35-44% of adults 75 years or older and 28-34% adults aged 65-74 are physically active (U.S. Department of Health and Human Services, 2017). More than 80% of adults do not meet the guidelines for both aerobic and muscle-strengthening activities. More specifically, less than 5% of adults participate in 30-minutes of physical activity each day. The low engagement of older adults in physical activity and exercise is concerning, because this population group is more likely to be susceptible to cognitive decline due to increasing age as well as relatively high prevalence of other cardiovascular risk factors. Public health initiatives and efforts to increase awareness and engagement of older adults towards maintaining their physical health are therefore essential.

- (ii) Mental exercise/Brain or cognitive training: A large body of literature exists including randomized clinical trials and intervention studies, which show that

mental engagement/cognitive training interventions lead to improvement in several different domains of the cognitive function. Cognitive training is based on the idea that the brain, even in old age, can change for the better. The brain resembles muscles: In the same way that physical training improves physical abilities, cognitive training (or brain training) improves cognitive (or mental) abilities. Cognitive training uses guided practice on a set of tasks related to memory, attention, or other brain functions. This training can take many shapes. For instance, it can be conducted on the computer or delivered in person, individually or in small groups. But it typically involves using repetitive exercises designed to improve single (e.g., memory) or multiple (e.g., memory and reasoning) cognitive abilities (A. Kueider, Bichay, and Rebok, 2014). The Advanced Cognitive Training for Independent and Vital Elderly (ACTIVE) trial is a randomized, controlled, single-masked trial designed to determine whether cognitive training interventions (memory, reasoning, and speed of information processing), which have previously been found to be successful at improving mental abilities under laboratory or small-scale field conditions, can affect cognitively based measures of daily functioning (Jobe et al., 2001). Results from the trial demonstrated effectiveness and durability of the cognitive training interventions in improving targeted cognitive abilities. Interventions for speed, reasoning and memory-training showed reliable cognitive improvement immediately after the intervention period (Ball et al., 2002). Some other studies and reviews of cognitive training interventions have also shown overall significant effects on

cognitive functioning (Gross et al., 2012) (Bottiroli, Cavallini, and Vecchi, 2008; Cantarella, Borella, Carretti, Kliegel, and Beni, 2017; A. M. Kueider, Parisi, Gross, and Rebok, 2012; Mowszowski, Batchelor, and Naismith, 2010; Rebok et al., 2014; Willis et al., 2006). In addition to the in-person trainings, the last decade has seen a great emergence of computerized trainings and phone-based training applications (George and Whitehouse, 2011; Klimova, 2016; A. M. Kueider et al., 2012; Lau, Smit, Fleming, and Riper, 2016; Simons et al., 2016). These applications provide the ease of administration and personalized training which adapt to the performance levels of the user. Although more research to evaluate the long term effects of these training applications is needed, the utility of training the brain and keeping it active has been well established. Active engagement of older adults in brain training activities is thus warranted.

- (iii)** Cognitive leisure activities and social engagement: Leisure activities are those activities that people engage in for the purpose of enjoyment or well-being and are independent of work or activities of daily living (Verghese et al., 2006). Such activities have been reported to have health, social and psychological benefits (Lennartsson and Silverstein, 2001; Menec, 2003). Further, leisure activities have also been found to have benefits of lowering the risk of dementia by improving cognitive reserve. Among all leisure activities, the focus of interest for current research is on those that stimulate the cognitive components i.e., cognitive leisure activities. These include viewing television, listening to the radio, reading, playing games such as

cards, crosswords, or puzzles, etc. (Verghese et al., 2003). A review by Stern and colleagues concluded that participation in such cognitive leisure activities has potential to reduce the risk of developing Alzheimer's disease and other dementias (Stern and Munn, 2010). Some other reviews have also reported similar effects of cognitive leisure activities on cognitive health (Weih et al., 2007; Williams, Plassman, Burke, Holsinger, and Benjamin, 2010). Same studies also identified significant associations between social engagement and cognitive functioning. Weigh and coworkers reported that maintaining social contacts and regular engagement in cognitively stimulating activities were associated with a protective effect against the development of Alzheimer's disease. The study by Williams and coworkers also concluded that low social engagement, poor social networks and loneliness were associated with increased risk of Alzheimer's disease.

Reports from all the above mentioned resources suggest that the modifiable risk factors carry immense potential in altering the risk of developing Alzheimer's and other forms of dementia. Although public health campaigns promote these behaviors, engagement on the part of older adults, which is the more vulnerable group, is inadequate. In order to encourage active engagement in the preventive behaviors towards maintaining cognitive health, appropriate messages need to be disseminated to the target populations. These messages should address the prevailing concerns of the populations and should align with their existing beliefs and opinions regarding cognitive health. Therefore, efforts to design effective promotional messages should begin at understanding the perceptions and beliefs of older adults regarding cognitive health, their current utilization of one or more of the



preventive behaviors, their concerns and barriers towards carrying out the recommended behaviors. Since its move towards a public health perspective, cognitive health and its maintenance has been an important focus of several national healthcare organizations. A few of the efforts from these organizations focused on studying existing knowledge, perceptions, behaviors of communities towards cognitive health as discussed below.

### **What do Older Adults Know and Feel about Cognitive Health?**

The journal “Gerontologist” devoted a special issue to cognitive health called “Promoting Cognitive Health in Diverse Populations of Older Adults” (L. Anderson, Logsdon, Hochhalter, and Sharkey, 2009). This issue summarized set of articles that studied the existing perceptions and beliefs of older adults regarding cognitive health. Some of the findings are summarized below.

#### Attitudes and beliefs of older adults about healthy aging:

1. Living to advanced age – Being physically active, mentally sharp and having good memory, being independent and being socially active/engaged.
2. Social involvement and Interaction – Involves staying socially active such as being around people and involved in leisure activities such as dancing, singing, gardening, and travel. Aging well was also considered as engaging in volunteering and community service.
3. Mental attitudes – Having a positive attitude, not feeling sorry for oneself, being content, happy and not worrisome were some attributes believed to be associated with healthy aging. At the same time, managing stress, acceptance of their own

limitations and being able to cope with problems were also reported by older adults as ways to live a healthy aging life.

4. Cognitive abilities – Healthy aging was believed to be associated with having a sharp mind, clear thinking and, good memory. Being able to engage in cognitive activities and tasks such as playing cards, operating computers, engaging in good conversations were reported as signs of aging well. Some others reported additional markers of healthy aging as having active/busy lifestyle, being mobile, ability to continue work, living independently, and having few or no medical problems. Behaviors such as good eating habits, avoiding smoking and drinking and participating in fitness activities were also associated with maintaining healthy cognitive function and healthy aging.
5. Other themes that were reported to be associated with healthy aging were spiritual beliefs and staying active as a member in a faith community.

Among the several initiatives aimed towards promoting cognitive health, one was Center for Disease Control and Prevention's Healthy Brain Initiative: A National Public Health Roadmap to Maintaining Cognitive Health (<https://www.cdc.gov/aging/healthybrain/index.htm>). The approach aimed to move cognitive health into public health practice (Centers for Disease Control Prevention, 2007). One of the priority recommendations of this initiative was to determine how diverse audience think about cognitive health and its association with lifestyle factors. To address this priority, the Prevention Research Centers Healthy Aging Research Network (PRC-HAN) designed research to understand public attitudes about cognitive health and about the health behaviors associated with maintenance (J. N. Laditka et al., 2009). Focus

groups were conducted at several sites and findings from these efforts elicited some important issues regarding effective communication of health messages about cognitive health. Most of the research questions in the focus groups were based on understanding the attitudes across diverse cultural groups. However, a common theme that emerged across all groups was regarding the lack of effective media messages about cognitive health. Some of the findings are as follows:

- a. Source of information: Many participants mentioned that there was little or no information in the media about brain health (Friedman et al., 2009). Although most reported watching a lot of television, many heard almost nothing about brain health from TV. Some participants mentioned newspapers, magazines and other print media as sources of information for brain health.
- b. Media content about brain health: Participants reported that the media messages were confusing, conflicting and mixed messages about scientific evidence regarding relationships between healthy behaviors and healthy outcomes. This corresponds to findings from prior research that older adults are concerned with the quality of health and medical information in the media.
- c. Recommendations: One of several recommendations from the older adults for effective health messages was regarding the link between physical activity and brain health. This indicates that people may not always understand the association between lifestyle factors and brain health. Some others also suggested that health messages should be built on existing beliefs and should use cognitive health as a motivator for health behaviors (Logsdon, Hochhalter, Sharkey, and Workgroup, 2009).

Some other research studies also drew attention to some shortcomings in the content and communication of media messages about cognitive health. Research by Wilcox and colleagues found that although participants believed that physical activity promotes brain health, they were unsure about the frequency, duration and intensity that would be required to achieve benefits (Wilcox et al., 2009). Participants were also unsure about the type of diet that would benefit brain health. Wu and coworkers studied perspectives of older adults in West Virginia. They reported that participants were familiar with the terms “Alzheimer’s” and “dementia” but were unsure of their meanings (Wu, Goins, Laditka, Ignatenko, and Goedereis, 2009). Collectively, these studies draw attention to lack of effective health promotion messages in the context of cognitive health. In order to ensure adequate engagement in preventive behaviors against cognitive decline, Alzheimer’s and other dementia, it is imperative to develop effective health messages. The messages should be designed to provide adequate information which is easily understood by the target population.

### **Characteristics of Effective Health Messages**

One shortcoming of the available information resources is that they do not stress on the benefits of having a healthy brain or the consequences of having cognitive impairment. Although the effects may be implicit, it is essential that the target population receives adequate information and understands the implications of the suggested preventive actions. Research has shown that among the elderly, more the information provided, better is the demand for preventive care (Hsieh and Lin, 1997).

Understanding the importance of a health message in influencing behaviors is essential to ensure appropriate adoption of the behavior. An effective health message should convey

information about the issue at hand and should correspond to the prevailing concerns of the end user (Rothman, Salovey, Antone, Keough, and Martin, 1993). Additionally, the information in the message should have a maximum impact on people's thoughts and behavior, i.e. encourage initiating or maintaining healthy behavioral practices.

It is evident from previous research that older adults have certain specific beliefs regarding what constitutes healthy aging. However, the available information resources do not clearly align these existing beliefs with preventive actions that need to be undertaken. Briefly looking at some of the resources available on the internet providing any information on cognitive health, it was observed that seldom these messages clearly state the association between preventive behaviors and cognitive health. A few examples are stated below.

NOTE: Search terms 'cognitive health' or 'brain health' were entered on google search engine and the top results were studied:

1. National Institute of Health (NIH): Health and Aging

(<https://www.nia.nih.gov/health/cognitive-health>) – Provides information on different functions of cognitive health (e.g., Motor function, emotional function, etc.) and what do each of these functions mean. Also provides information about ways to maintain cognitive health. At the end, it states that the recommended behaviors may help in reducing the risk of cognitive impairment and dementia. However, no information is explicitly provided about what are the benefits/harms of healthy/impaired cognitive function.

2. NIH: Health and Aging – Brain health resource: One page leaflet – Provides information on risk factors of brain disease and those that can be controlled to keep brain healthy. Also provides some links to more information resources.
3. Alzheimer's association ([http://www.alz.org/brain-health/brain\\_health\\_overview.asp](http://www.alz.org/brain-health/brain_health_overview.asp)): Brain Health – Provides information on modifiable factors that can keep brain healthy.

Again, no explicit information about the benefits/harms of healthy/impaired cognitive function.

Cognitive decline is a concerning issue for many older adults (Connell, Roberts, and McLaughlin, 2007). Therefore health messages linking physical activity, proper nutrition and other preventive behaviors to maintenance of cognitive health may motivate them to adopt these healthy behaviors (Wilcox et al., 2009). In accordance, further research is required to delineate what constitutes an effective health message and how can it influence perceptions, attitudes and behaviors.

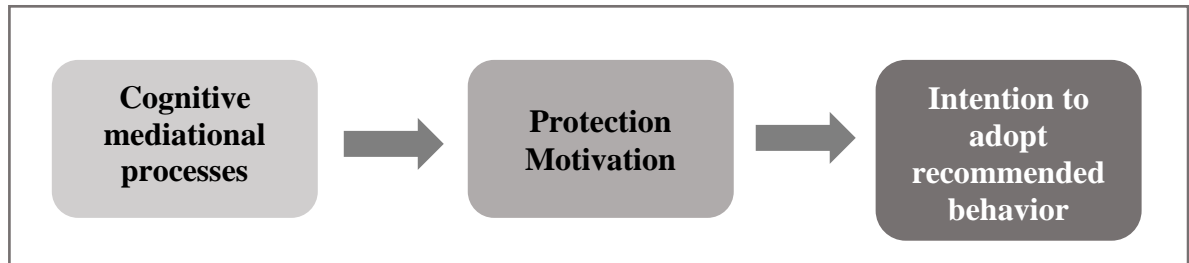
### **CHAPTER 3: THEORY AND MODEL**

The following chapter includes discussion of social and behavioral concepts from psychology, which were used to develop the conceptual model for the study. The chapter also discusses operationalization of the conceptual model in the context of preventive behaviors towards maintenance of cognitive health.

#### **Persuasion towards a Preventive Behavior: A Protection Motivation Appeal**

The sole purpose of public health messages promoting preventive behaviors is to create awareness among the desired populations and to motivate them to engage in the recommended behaviors. In other words, the health messages need to be persuasive and should bring about the initiation and maintenance of the recommended action among the target audience. This action or recommended behavior, in the prevention domain, is directed towards preclusion of an undesirable event. However, psychological research states that often times, an individual is not affected by even the direst events unless the events are perceived or understood. The perception of such a dreadful event is what drives the motivation to protect oneself from the event, as explained by Rogers' Protection Motivation Theory (Rogers, 1975). According to the theory, the intent to adopt the communicator's recommendation is mediated by the amount of protection motivation aroused. Protection motivation is believed to be an intervening variable that has characteristics of a motive: it arouses, sustains, and directs activity. This protection motivation in turn arises from a cognitive appraisal process of a depicted event as (a) noxious and (b) likely to occur, coupled with the belief that a recommended behavior/action can effectively prevent the occurrence of the aversive event. The process is depicted in the diagram below.

**Figure 3-1: Schematic Representation of Processes in Roger's Protection Motivation Theory**



*Conceptualizing the theoretical postulates in the context of preventive behaviors towards cognitive health maintenance:* The ultimate undesirable/aversive event under consideration is decline of cognitive health (possibly towards Alzheimer's or other dementia). The recommended preventive behaviors/actions are directed towards preclusion of the cognitive decline i.e. towards maintenance of healthy cognitive function. Applying Rogers' theory, the intent to initiate and maintain the recommended preventive behaviors will depend on the motivation to protect oneself from cognitive decline. This motivation in turn will depend on the perceptions of how noxious cognitive decline is, the likelihood of occurrence of cognitive decline for oneself and the belief that engaging in the recommended preventive behaviors will effectively prevent cognitive decline. These three perceptions were collectively termed as cognitive mediational processes, which are likely to depend on how well the event of cognitive decline is understood: what is cognitive health? what entails cognitive decline? what effect does it have on one's life? and similar other aspects of the event. In the following sections, we will look at how each of the variables involved in the process of protection motivation is



manifested and how it can be utilized in effective promotion of the preventive behaviors towards cognitive health maintenance.

### **Fear Appeal, Perceptions and Protection Motivation**

A primary premise upon which the protection motivation theory (PMT) was developed is fear appeals (Norman, Boer, and Seydel, 2005). The origins of PMT lie in early work on the persuasive impact of fear appeals that focused on the conditions under which fear appeals may influence attitudes and behavior. The theory postulates that fear acts as a driving force that motivates behavior. It is this fear that drives the cognitive mediational processes of appraisal of severity and likelihood of the depicted undesirable event. If a communication evokes fear, it will motivate the recipient to reduce the unpleasant emotional state. If the communication also includes behavioral advice (in this case, recommendation to engage in preventive behaviors), following the advice may be one way to reduce the threat from the unpleasant event. PMT outlines that the cognitive mediational processes result from fear appeals. Fear appeals have been found to have several different component i.e. fear can be altered by varying information of several different topics such as personal relevance to the undesirable event, likelihood of occurrence of the event, recommended responses etc. With advancing research, multiple components of fear appeal were identified and several dependent variables were found to co-vary with varying levels of fear. Higher levels of fear arousal were found to have more persuasive power as compared to lower levels of fear arousal. One of the earliest analyses of the effect of fear arousals on persuasion, fear appeals were described as the contents of communications describing the unfavorable consequences that may result from failure to adopt the communicator's recommendations (Horowitz, 1969; Rogers, 1975). The

communication should be impactful in generating appraisals that the event is severe and likely to occur (i.e. appraisal of the cognitive mediational processes).

In terms of operationalization of the cognitive mediational process and fear appeal in the context of cognitive health, adoption of recommended preventive behaviors will likely depend on the fear cognitive decline. As per PMT, the fear of cognitive decline will be manifested as the perceptions of severity of cognitive decline and the likelihood of occurrence of cognitive decline for oneself. This coupled with the belief that the recommended preventive behaviors will lead to avoidance of cognitive decline, will bring about the desired motivation to engage in the preventive behaviors. The perceptions of fear of cognitive decline can stem from various resources such as personal experiences and/or knowledge and awareness about the importance of healthy cognitive function in living a healthy life. It is the public health messages and communications from various media resources that the information about cognitive health reaches the populations, and subsequently plays a role in forming the knowledge structure and awareness among the masses. Therefore, an effective healthcare message should aim at providing adequate and relevant information in a manner that leads to fear arousal among the target population.

### **Fear Appeal in the context of Brain Health or Cognitive Health and its likely influence on actions**

Although fear appeal has been demonstrated to have positive effects in persuasion towards certain behaviors, some other researchers have reported negative effects of fear on behaviors.(Peters, Ruiter, and Kok, 2013; Tannenbaum et al., 2015). A meta-analysis by Tannenbaum and colleagues discuss about two fear-appeal models: linear model (Witte and Allen, 2000) and curvilinear model (Hovland, Janis, and Kelley, 1953).

Although both models propose that exposure to fear increases motivation towards the recommended action, the two models have differing postulates regarding the type of effect fear appeal have on attitudes, intentions and behaviors. According to the linear model, fear has positive and monotonic influence on attitudes, intention and behavior such that high depicted fear has more influence than moderately depicted fear. On the other hand, the curvilinear model states that high fear elicits defensive avoidance due to which the message recipients tend to disengage from the message. This reaction is in an effort to avoid further exposure to the message because it is too frightening. In such cases, fear may bring about less persuasion and more avoidance.

Dementia and Alzheimer's diseases have been reported to be the second most feared diseases after cancer (Alzheimer's Association, 2017). At the same time, there is considerable stigma associated with dementia which may distort individuals from seeking help (Batsch and Mittelman, 2015). A study assessing public perceptions regarding presymptomatic testing for AD revealed that personal fear of the results was one of the top reasons for not wanting genetic testing (Caselli et al., 2014). Other studies evaluating public perceptions about dementia reported that older adults feared developing the condition, had anxieties about loss of self-identity and dignity and, were reluctant to contact health professionals about memory problems (Corner and Bond, 2004) (French, Floyd, Wilkins, and Osato, 2012).

It is unclear whether the existing fear about dementia and Alzheimer's is beneficial or detrimental for encouraging older adults to take preventive actions. Advertisement campaigns for dementia and Alzheimer's prevention are often found to focus on the negative aspects of the disease condition and its devastating impact on life. However,

little data exists on how the fear arousal via media resources affect behaviors among older adults. The current study aimed to investigate this effect of fear appeal on intention towards preventive behaviors.

### **Altering Fear Appeal using Goal Framing**

As mentioned earlier, one way to describe fear appeals is by the contents of communications which explain the unfavorable consequences resulting from failure to adopt the recommended actions. In other words, fear can be aroused by informing the subjects about the negative consequences of a particular course of action/inaction. This correlates with the concept of goal-framing or message-framing. Research on framing effects on behavior explains how framing a message to express either benefits of adopting a particular behavior (positive-framing) or the costs of failing to adopt a behavior (negative-framing) can alter a message's persuasive impact (Rothman, Kelly, Hertel, and Salovey, 2003; Rothman et al., 1993; Rothman, Stark, and Salovey, 2008). Based on the understanding of fear appeals and message-framing, we can assume that message-framing can alter the level of fear appeal of a particular message. The following sections will help in better understanding of message-framing effects on health behaviors.

#### *Overview of Health Message Framing*

Information about a health behavior can emphasize the benefits of taking action (i.e., a gain-framed appeal) or the costs of failing to take action (i.e., a loss-framed appeal). For example, a health message about testing for HIV can explain the benefits of taking an HIV test such as – feeling peace of mind, and feeling less anxious if you test negative. The message can also explain the costs of HIV testing such as – not feeling peace of mind and feeling anxious about your HIV status. People's preferences are believed to

vary depending on the frame. The manner in which a message frame influences persuasion is dependent on the nature of the health behavior promoted, origins of which lie in the prospect theory. The principle that framing of information can affect people's behavioral decisions was motivated by the framing postulate of prospect theory (Tversky and Kahneman, 1985). According to prospect theory, people tend to avoid risks when considering potential gains afforded by a decision (they are risk averse in their preferences) but are willing to take risks when considering the potential losses afforded by their decision (they are risk seeking in their preferences). Therefore, the influence of a given frame on the behavior depends on whether the behavior under consideration is perceived to reflect a risk averse or a risk-seeking course of action. Consistent with this perspective, Rothman and colleagues developed a taxonomy of health-relevant situations to classify them as risk seeking or risk averse (Rothman, Bartels, Wlaschin, and Salovey, 2006). According to this taxonomy, when people are considering a behavior that they perceive involves some risk of an unpleasant outcome (e.g., it may detect a health problem), loss-framed appeals should be more persuasive. When people are considering a behavior that they perceive involves a relatively low risk of an unpleasant outcome (e.g., it prevents the onset of a health problem), gain-framed appeals should be more persuasive. Preventive behaviors fall under the category of risk-averse behaviors. The primary function of preventive behaviors is to prevent the onset of illness and maintain a person's current health status. Thus the framework of prospect theory and framing together suggest that gain-framed appeals would be more effective in promoting the use of prevention behaviors. Detection behaviors on the other hand, such as screening for cancer, would be more persuasive with a loss-framed message. Research evaluating gain

and loss frames have studied behaviors such as cancer screenings and sunscreen use. Though some studies produced results consistent with postulates of risk-seeking and risk-averse nature of the behaviors, some other studies failed to produce the desired effects. In the domain of preventive behaviors, certain studies promoting use of sunscreen have produced more persuasion with gain frames as compared to loss frames. The effects however have not been tested extensively in other prevention behaviors and therefore need further evaluation. In the domain of detection behaviors, a study involving efforts to get women to take action following an abnormal screening test, both framing scenarios had high compliance rates (Lauver and Rubin, 1990; Lerman et al., 1991). The effects were possibly due to a high motivation among the subjects resulting from the knowledge of an existing medical problem.

Considerable research has examined the effect of framing on the persuasion towards health behaviors. However, the inconsistent findings regarding the effectiveness of the gain and loss frames lead to the emergence of the idea that there are other specific mechanisms that underlie the persuasion effects of message frames. Two of these mechanisms (or moderating variables) that will be discussed below are: (i) The effect of regulatory focus on framing by Higgins (Higgins, 1987) and; (ii) The effect of involvement on framing (Rothman and Salovey, 1997).

### **Regulatory Focus and Framing Effects on Persuasion**

The thesis underlying the concept of regulatory focus is an extension to the basic motivation principal that individuals approach pleasure and avoid pain. Higgins proposed his theory of a self-regulatory model to allow for distinct types of desired end states that are related to distinct types of self-regulatory strategies (Higgins, 1998). According to

this theory, some people primarily focus on hopes and aspirations and pursue goals that afford them the opportunity to seek out favorable outcomes (i.e., a promotion-oriented perspective), whereas other people primarily focus on duties and obligations and pursue goals that afford them the opportunity to avoid unfavorable outcomes (i.e., a prevention-oriented perspective). Recent research has provided considerable evidence that these two self-regulatory strategies are associated with distinct strategic inclinations, whereby promotion focus is related to strategic eagerness, and prevention focus is related to strategic vigilance (Higgins, 2000; Lee and Aaker, 2004). Although any goal may be pursued with either a promotion or prevention focus, some goal are more compatible with a particular self-regulatory strategy, resulting in higher level of “fit”. This higher level of fit occurs because striving for a gain (benefits from a goal attained) involves more eagerness than guarding against a non-gain (not attaining the benefits from an outcome), and guarding against a loss (attaining a negative outcome) involves more vigilance than striving for a non-loss (not attaining a negative outcome) (Yi and Baumgartner, 2009). This has been demonstrated in a study conducted by Lee and colleagues, where appeals presented in the gain-frame were more persuasive when the message was promotion focused whereas loss-framed appeals were more persuasive in prevention focused frames. The same study also demonstrated that perception of health risk was higher in prevention appeals than in promotion appeals.

For better understanding, the examples used in the study are presented below:

**Product:** Grape Juice (Objective was to persuade subjects to drink the grape juice)

**Promotion focus:** This appeal focused on content which indicated that the juice generated energy (Gain-frame: Get-energized!; Loss frame: Don't miss out on getting energized)

**Prevention focus:** This appeal focused on content which indicated that drinking juice may contribute to healthy cardiovascular function and reducing risk of some cancers and heart disease. (Gain-frame: Prevent clogged arteries!; Loss frame: Don't miss out on preventing clogged arteries)  
[NOTE: 'Prevention-focus' is separate than 'preventive-behaviors' and should not be confused with each other. A message for a preventive-behavior can be 'promotion-focused' or 'prevention-focused']

*Framing, regulatory-focus and preventive behaviors for cognitive health*

The above mentioned theory provides important guidance for designing effective health messages, some of which can be applied to the context of framing messages for cognitive health promotion, as discussed below.

Applying the regulatory focus postulate to the context of promoting behaviors towards cognitive/brain health maintenance, promotion- and prevention-focus can be framed as follows:

*Promotion focus:* This focus can be looked at as promotion towards a healthy brain i.e. having healthy brain-function. Messages framed using the promotion-focus can emphasize the benefits of having a healthy-brain which include healthy-aging, retaining independence in later life, being able to care for themselves and their families, being cognitively capable to manage regular activities like paying bills, and other benefits. As per Lee and colleagues, messages promoting the benefits of healthy brain are more persuasive when framed positively (or gain-framed) as compared to those framed negatively (loss-framed). Therefore, public health messages designed should incorporate positive anchors such as "If you engage in (XYZ preventive behaviors), aging can be easy".



*Prevention focus:* This focus can be looked at as prevention against decline in brain health and decline in cognitive function. Messages framed using prevention-focus can emphasize the prevention of harms of having a declining brain-function such as inability to perform daily activities, forgetting important information such as appointments and names, losing independence and having to rely on others for daily activities, increased risk of diseases such as Alzheimer's disease and other negative outcomes. Messages using a prevention-focus are more persuasive when frames negatively (or loss-framed) as compared to those framed positively (gain-framed). Public health messages using the prevention focus should use anchors such as "If you do not engage in (XYZ preventive behaviors) you miss-out on preventing decline in your brain health"

Using appropriate regulatory-focus and corresponding framing, promotional messages to increase engagement in behaviors towards healthy brain functioning can be designed.

## **The Role of Involvement**

### *Involvement and behaviors*

Before we understand why and how the construct of involvement relates to the decision making regarding preventive behaviors towards cognitive health, let us look at what is involvement from its origin in psychology and marketing domains.

The origins of involvement lie in social psychology and specifically from the persuasive communication literature, where attitude and attitude change was explained using social judgement-involvement approach (Michaelidou and Dibb, 2008) (Sherif and Sargent, 1947; Sherif, et al., 1965; Sherif and Sherif, 1967). The social-judgement approach explained the effect of involvement on how individuals judge received messages.

Extending from this conceptualization, several other researchers defined and applied the concept of involvement in marketing, particularly consumer behavior. Houston and Rothschild (1978) and Rothschild (1979) suggested that involvement has three forms or types: enduring, situational and response.

Involvement was first linked to marketing following Krugman's (1967) measurement of involvement with advertising. Since then, and especially in the 1980's, intensive attention from consumer researchers has generated a bulk of literature which has conceptualized and measured involvement in multiple contexts including involvement with: a product class (e.g., (Laurent and Kapferer 1985; Zaichkowsky 1985; Rahtz and Moore 1989; Kapferer and Laurent 1993; Zaichkowsky 1994; Michaelidou and Dibb 2006) a purchase decision (e.g.(Slama and Tashchian 1985; Mittal and Lee 1989; Smith and Bristor 1994), a service (Keaveney and Parthasarathy 2001) advertising or message processing (Mitchell 1981; Petty, Cacioppo et al. 1983; Vaughn 1986; Lacznia, Muehling et al. 1989; Zaichkowsky 1994). Celsi and Olson (1988) further explicate involvement as essentially perceived personal relevance. Perceived relevance is a function of a consumer's perceptions of his/her needs, goals and values and their congruence with the consumer's knowledge of the product category. More specifically, the personal relevance of a product is represented by the perceived linkage between an individual's needs, goals, values (self-knowledge) and their product knowledge (attributes and benefits). The greater the perceived linkage, the stronger are the feelings of personal relevance to the product category. Irrespective of the specific variations in defining involvement, there is a consensus among many researchers that the essence of involvement is perceived personal

relevance (Petty, Cacioppo et al. 1983; Zaichkowsky 1985; Celsi and Olson 1988; Higie and Feick 1989).

Involvement can be viewed as the motivation to process information (Sansgiry, Cady et al. 2001). Involvement refers to "the level of perceived personal importance and/or interest evoked by a stimulus (or stimuli) within a specific situation". This definition implies that aspects of the person, the product, and the situation all combine to determine the consumer's motivation to process product related information at a given point in time. Highly involved consumers process information actively (Krugman 1965; Engel, Kollat et al. 1973) and therefore their attitudes would be expected to polarize.

When consumers are intent on doing what they can to satisfy a need, they will be motivated to pay attention and process any information felt to be relevant to achieving their goals. On the other hand, a person may not bother to pay any attention to the same information if it is not seen as relevant to satisfying some need. Translating the effects of involvement to message framing, Maheswaran and Meyers-Levy propose that the level of involvement determines the type of processing evoked: heuristic or systematic.

#### *Involvement and message framing*

As borrowed from the psychology and marketing literature, the concept of involvement has been extensively used to understand health behaviors. One postulate explaining the effect of involvement on behaviors through the type of processing it evokes. According to this postulate, the level of involvement will determine the type of message framing that will evoke the most persuasion (Maheswaran and Meyers-Levy, 1990; Meyers-Levy and Maheswaran, 2004). It is predicted that loss-frame messages are more effective when people are involved with an issue and are systematically processing the message, whereas

gain-framed messages will be more effective when people are not involved with an issue and are heuristically processing the message. Systematic processing involves judgments based on detailed scrutiny and the perceived diagnosticity of message data. Heuristic processing involves uneffortful and simple decision rules that often relate to surface message feature (Meyers-Levy and Maheswaran, 2004). The type of processing thus evoked (by involvement) determines the type of framing which carries the highest persuasive power. When an individual is highly involved, systematic processing is evoked whereas when an individual is not highly involved, heuristic mode of processing is evoked. In conclusion, high involvement leads to systematic processing, which in turn makes a loss-framed message more persuasive than a gain-framed message. This thesis is predicted on the assumption that negatively worded arguments in the loss-frame are always stronger than positively worded arguments in the gain-frame.

While consumer researchers have adopted various conceptualizations of involvement, it is commonly accepted that there are following two distinct types of involvement (Houston and Rothschild 1978; Laurent and Kapferer 1985; Richins, Bloch et al. 1992).

- a. **Enduring involvement** (EI) is defined by Richins and Bloch (1986) as "an ongoing concern with a product," and is due to internal consumer characteristics that define certain products as inherently interesting to an individual.(Childers and Houston, 1984) Enduring involvement is also referred to as intrinsic involvement. It indicates the level of interest a consumer has in a product. This involvement is generally stable and cannot be changed easily.

- b. **Situational involvement** (SI), "occurs only in specific situations, such as a purchase". SI reflects adaptation to external circumstances, rather than individual characteristics, and is often heightened by the need to make a choice regardless of enduring involvement with the product.(Bhansali, Fleming, Sherer, and Sansgiry, 2016). In the current study, SI will be manipulated and measured. Manipulation of situational involvement will facilitate the understanding of how individuals respond to certain messages in different involvement scenarios (high versus low). In reality, individuals may come across both high and low involvement situations in their routine lives. As a result, while studying the effects of message framing, it important to consider the level of involvement. Manipulations of level of involvement will allow to study framing effects independently. It will also allow to understand which framing effects act as most persuasive in a specific type of involvement situation, learnings from which can be thus used to design effective promotional messages.

Applying the involvement and framing concepts to the current study objective or promoting engagement in preventive behaviors for cognitive health; the study will evaluate the effect of framing under the context of involvement on the outcome variables. In the context of cognitive health or brain health, older adults may come across promotional messages via various resources such as internet, newspapers, hearing from a friend, at doctor's clinic, etc. Depending on the situation and the manner in which they are exposed to the information, they will either be highly involved while reading the messages or will not be involved at all (and may just browse through superficially). To

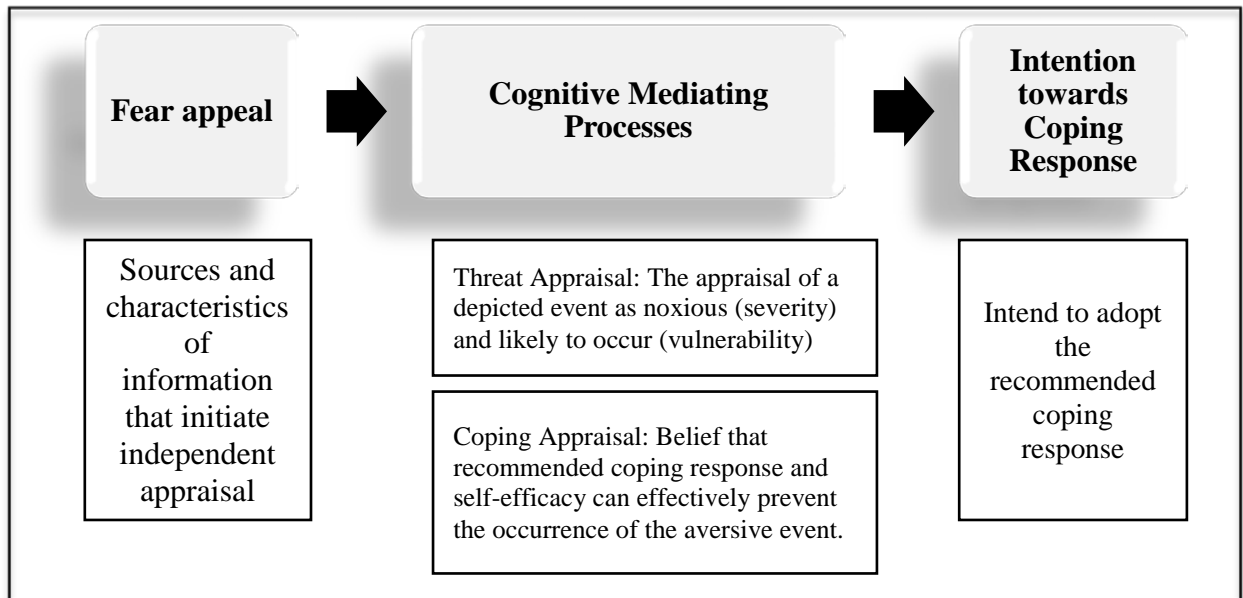
study framing effects clearly, the involvement level can either be controlled or can be manipulated to allow for independent observation of the framing effects in the manipulated situations. In the current study, we will use the later method.

### **Proposed Model**

The final proposed model was developed using Rogers' Protection Motivation Theory and the concepts of goal-framing, regulatory-focus and involvement as discussed above.

The stepwise development of the proposed-model is represented in the schematic diagram below:

**Figure 3-2: Rogers' Protection Motivation Theory**



## Operational Model and Definitions

Operationalizing the model to assess the study objective, the model constructs will be defined as follows:

*Involvement*: Manipulated as two levels as high situational involvement and low situational involvement with respect to the level of personal relevance of the issue of healthy brain function or cognitive decline for the subject.

*Message framing*: Manipulated as gain-frame and loss-frame wherein gain-frame emphasizes the benefits of engaging in recommended preventive behaviors and the loss-frame emphasizes the harms of not engaging in recommended preventive behaviors.

*Perceived-severity*: Perceptions and evaluations of seriousness of brain health decline (4 items)

*Perceived vulnerability*: Perception of likelihood of occurrence of brain health decline for themselves (4 items)

*Response-efficacy*: Beliefs about the effectiveness of recommended behaviors in preventing brain health decline

*Self-efficacy*: Belief that one can ably carry out the recommended action or behavior.

*Recommended coping response*: Preventive behaviors (physical activity, mental exercise, healthy diet, controlling cardiovascular conditions, and staying socially engaged)

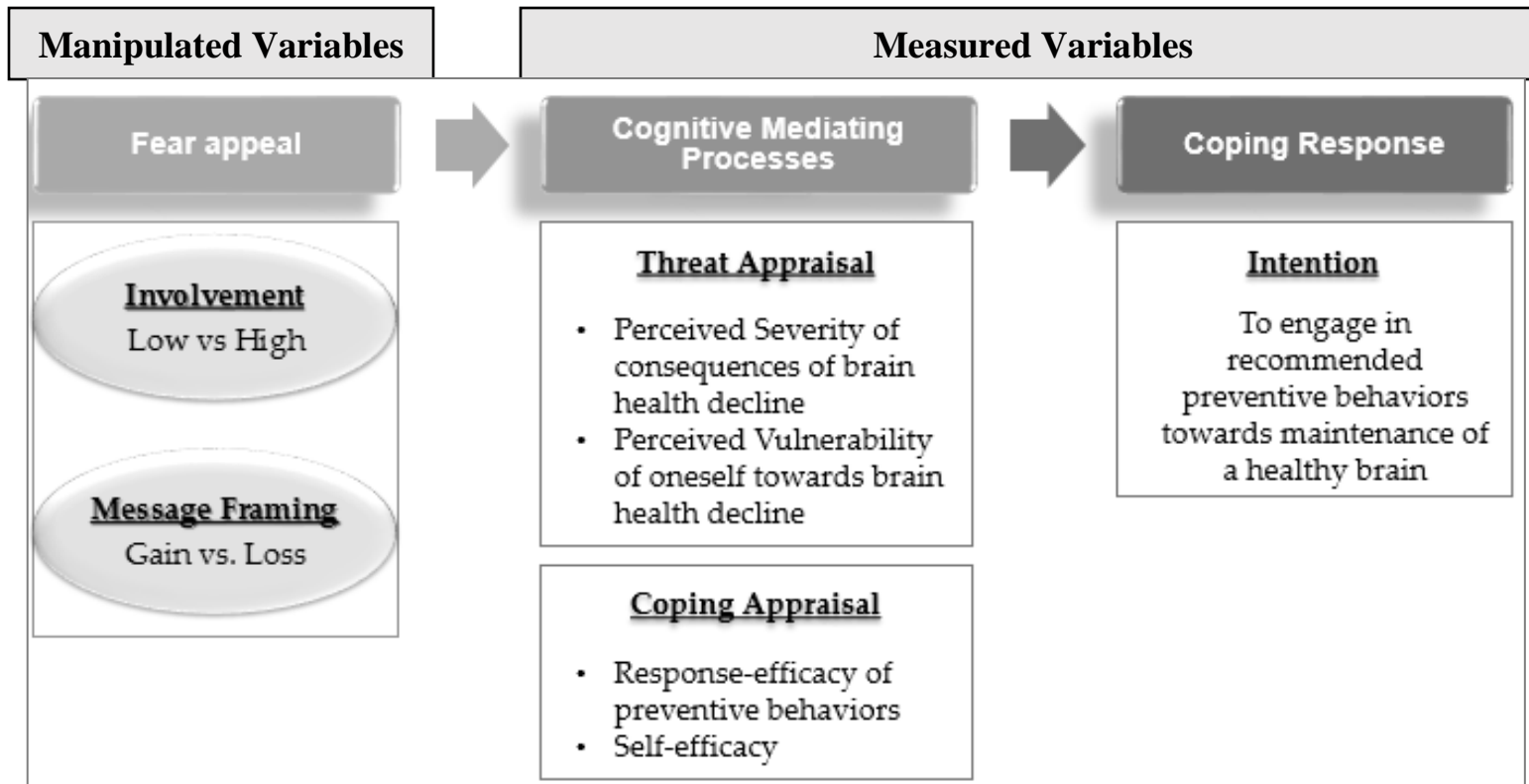
*Intention*: Measured as intention to engage in the recommended preventive behaviors (4 questions)

*Control Variables*: These include the factors other than model constructs that are likely to affect intention: Expectation-regarding-age [ERA] (cognitive component borrowed from a previously validated scale), General health behaviors, General health status, Previous

exposure to counseling or information about brain health, Previous tests/diagnosis of any brain diseases, Presence of family history of Alzheimer's or other dementia, Age, Gender, Education, Insurance status, Race/ethnicity, and current living conditions.



Figure 3-3: Operational Model for the study based on Rogers' Protection Motivation Theory



## **Study Hypotheses**

Considering the above model developed and the constructs discussed, following hypotheses will be tested.

### ***Effect of Involvement***

H1: There is an effect of involvement on constructs of Protection Motivation Theory

H1a: There is an effect of involvement on perceived severity of consequences of decline in healthy brain function

H1b: There is an effect of involvement on perceived vulnerability towards decline in healthy brain function

H1c: There is an effect of involvement on response-efficacy of the recommended preventive behaviors in preventing decline in brain function

H1d: There is an effect of involvement on self-efficacy in engaging in the recommended preventive behaviors

H1e: There is an effect of involvement on intention towards in engaging in the recommended preventive behaviors

### ***Effect of Message-framing***

H2: There is an effect of message-framing on constructs of Protection Motivation Theory

H2a: There is an effect of message-framing on perceived severity of consequences of decline in healthy brain function

H2b: There is an effect of message-framing on perceived vulnerability towards decline in healthy brain function

H2c: There is an effect of message-framing on response-efficacy of the recommended preventive behaviors in preventing decline in brain function

H2d: There is an effect of message-framing on self-efficacy in engaging in the recommended preventive behaviors

H2e: There is an effect of message-framing on intention towards in engaging in the recommended preventive behaviors

***Interaction effect of Involvement and Message-framing***

H3: There is an interaction effect of involvement and message-framing on constructs of Protection Motivation Theory

***Effects within Measured variables***

H4: There is an association between perceived severity, perceived vulnerability, response-efficacy and self-efficacy with intention to engage in preventive behaviors towards maintenance of a healthy brain

## **CHAPTER 4: METHODS**

Due to the applied nature of this research, concepts from other fields such as marketing, psychology, and consumer behavior were used to develop the methodology. In order to determine the impact of message framing and involvement on intention to engage in preventive behaviors, following steps were accomplished:

- 1) Identification of the study design
- 2) Selecting Preventive Behavior/s for maintenance of cognitive health.
- 3) Development of involvement for involvement manipulation.
- 4) Development of message framing (positive and negative) for framing manipulation.
- 5) Development of study instrument using Qualtrics
- 6) Conducting pilot tests and modification of the instrument.
- 7) Collection of data, data coding and analyses.

## **Study Design**

The study was an experimental, cross-functional, and a 2X2 factorial design. Two factors i.e. independent variables (IVs) of (i) message framing and (ii) involvement, were manipulated in the study. The study was implemented as a field-experiment. Field studies are strong in realism, significance, strength of variables, theory orientation and heuristic quality (Kerlinger and Lee, 1999). Field Experiments are done in the everyday (i.e. real life) environment of the participants. The experimenter still manipulates the IV, but in a real-life setting (so cannot really control extraneous variables). The advantages of a field experiment are:

- i. Behavior in a field experiment is more likely to reflect real life because of its natural setting, i.e. higher ecological validity than a lab experiment.
- ii. There is less likelihood of demand characteristics affecting the results, as participants may not know they are being studied.

## **Manipulated and Measured Variables**

### *Manipulated variable 1: Involvement*

Involvement was manipulated at two levels. As explained earlier sections, the involvement in this study was defined as situational involvement, i.e. situations (or scenarios) were used to manipulate involvement at two levels: (i) High Involvement and (ii) Low Involvement. Manipulation of involvement was based on the idea that in real world, certain people are generally aware about health issues and therefore may also be aware of Alzheimer's disease and the associated risk factors, protective/preventive behaviors and related information. At the same time, certain others may have had a 1<sup>st</sup>

hand experience with being a caregiver for a friend or a relative with Alzheimer's disease. Naturally, awareness and knowledge may alter the perceptions of risk for oneself and may influence their propensity towards engaging/or not engaging in a particular behavior. In other words, an individual may have high involvement in the context of Alzheimer's disease.

As a result, when they are exposed to information about brain health and Alzheimer's, due to their natural high involvement, systematic processing may be evoked, which may eventually have an influence on the effect of framing. For the study experiment, to ensure a high involvement scenario, a vignette was created using two cues:

- i) A close friend being diagnosed with early-onset Alzheimer's disease as a result of having family history of Alzheimer's disease.
- ii) The individual himself/herself having family history of Alzheimer's disease – Father and Aunt (deceased).

The cue of a close friend being diagnosed with early-onset Alzheimer's was used as a stimulus to think about the possibility of being diagnosed at an age younger than normally seen. Early-onset Alzheimer's affects people younger than 65 years of age. It accounts for 5% of the total cases of Alzheimer's disease. The causes for this type of Alzheimer's are not clearly known however scientists have pinpointed several rare genes that directly cause Alzheimer's. People who inherit these rare genes tend to develop symptoms in their 30s, 40s and 50s. When Alzheimer's disease is caused by deterministic genes, it is called "familial Alzheimer's disease," and many family members in multiple generations are affected.

The cue of having family history was used due to the well-established fact that family history is one of the biggest risk factors for developing Alzheimer's disease (Alzheimer's Association, 2017). Individuals who have a parent, brother or sister with Alzheimer's are more likely to develop the disease than those who do not have a first-degree relative with Alzheimer's (Green et al., 2002; Loy, Schofield, Turner, and Kwok, 2014). Those who have more than one first-degree relative with Alzheimer's are at even higher risk of developing Alzheimer's disease (Lautenschlager et al., 1996). When diseases run in families, heredity (genetics), shared environmental and lifestyle factors (for example, access to healthy foods and level of physical activity), or both, may play a role. The increased risk associated with having a family history of Alzheimer's is not entirely explained by whether the individual has inherited the APOE-e4 risk gene.

As opposed to high involvement where the individual is primed by providing information about Alzheimer's, in the low involvement scenario, no information about Alzheimer's was provided. In addition, exposure to the framing vignette was presented as a pop-up ad that appears during online-shopping. The context of a pop-up ad was used based on concepts from marketing and advertisement which state that incidental exposure to information (i.e. when the ad is not the primary interest of the reader), consumers may hardly glance at the advertisement (Fennis and Stroebe, 2015). The attention paid to the information in such a case may be much less when compared to a situation where the intention is to look for information concerning that very product/service/topic. Thus, for the current study, a vignette was created which primed the individual to imagine a general on-line shopping scenario and that they see a pop up advertisement while they are

shopping online. The information about brain health and preventive behaviors is presented as the pop-up advertisement.

### *Manipulated variable 2: Framing*

Framing was manipulated at two levels: (i) Positive framing and (ii) Negative framing.

The primary objective was to provide information about brain health and promotion of preventive behaviors. The construct of framing was used to present the information in either a positive frame i.e. benefits of having a healthy brain (free from brain-diseases like Alzheimer's) in old-age or a negative frame i.e. consequences of having a brain disease like Alzheimer's. The framing message had 3 segments: (i) Title, (ii) Main text (information about what one can experience if one has a health brain/brain disease like Alzheimer's) and, (iii) Information about a preventive behavior. The sections below will each explain the development of each of the segments in detail:

(i) Title: The title of the framing advertisement consisted of two lines. The first line was common for both positive and negative frames "Brain Health and Aging". The second line was structured to provide information about prevention and how it can impact life. In the positive frame, the statement used was "A Step towards Prevention for a Lifetime of Prosperity." The negative frame statement was "Lack of Prevention can lead to a Dark and Lonely future." Both the statements communicate the future-consequences of an action i.e. prevention/lack of. The consequences of 'Lifetime of Prosperity' and 'Dark and Lonely future' were selected based on the findings from a study by Laditka and colleagues on attitudes of older adults about aging well (S. B. Laditka et al., 2009).

(ii) Main text: This was the main segment where the construct of positive and negative framing was used to develop the statements. The positively framed message presented



information about what life would be like in old age, if one maintains a healthy brain and is free from brain diseases like Alzheimer's. This was based on literature review and communication with individuals belonging to the target age-group (40-60 years). In the report by Laditka and colleagues, some of the themes identified as aging-well were – living to an advanced age, being socially active, having good memory, being physically active, being independent and being able to work (S. B. Laditka et al., 2009). Similar themes were found when certain local individuals were asked regarding their idea of healthy aging. At the same time, most of the information for promoting preventive behaviors for cognitive health which are available via various media sources contain such themes. Inclusion of such themes in the positive framing therefore also served as a prototype of current standard promotional messages.

As for the negative framing, the basis of 'fear of Alzheimer's disease' was used. A number of studies have reported that older adults fear Alzheimer's disease (or dementia in general). In a study conducted by French and co-workers to develop and validate 'Fear of Alzheimer's Disease' scale, factors which included the themes of 'losing all independence', 'relying on someone else', 'being a burden on the family' had high factor loadings (French et al., 2012). Another study reported 'loss of self-identity and dignity' as a factor contributing to fear of Alzheimer's disease (Corner and Bond, 2004). These themes were incorporated in the negative framing message. A report by Alzheimer's Association on challenges facing Alzheimer's Disease management, one of the barriers to public awareness was lack of understanding of what Alzheimer's disease feels like amongst those who are cognitively healthy. Keeping these findings in mind, the negative

framing was such developed as to give the reader an image or what would it feel like to have Alzheimer's disease.

(iii) Information about a preventive behavior: Since the main text included manipulations of positive and negative framing, the final statement which included information about the preventive behavior was kept constant and neutral in both the framing, so as to minimize the effect of any extraneous factors. In choosing a preventive behavior for maintenance of cognitive health, cognitive/mental stimulation was used. No other behaviors were used in the framing because inclusion of multiple behaviors may cloud the effect of framing itself.

*Measured variables:*

Overall there were 5 measured variables for the research model, specifically, perceived severity, perceived vulnerability, response-efficacy, self-efficacy and intention.

(i) Perceived severity: Perception of severity of a brain-disease like Alzheimer's. Questions to measure perceived severity were adopted from a study by Galvin et. al. The study developed and validated a population-based questionnaire to explore psychosocial determinants of intention to screening for memory loss and Alzheimer's disease (Galvin, Fu, Nguyen, Glasheen, and Scharff, 2008). Perceived-severity was measured using 3 items with responses measured on a 7-point Likert scale (1=strongly disagree to 7=strongly agree).

(ii) Perceived vulnerability: Perceptions of susceptibility or the likelihood of developing a brain-disease like Alzheimer's in the future. The questions used to measure perceived vulnerability were also adopted from the study conducted by Galvin and co-

workers. Perceived-vulnerability was measured using 3 items with responses measured on a 7-point Likert scale (1=strongly disagree to 7=strongly agree).

(iii) Response-efficacy: Belief that engaging in the recommended preventive behaviors will decrease one's likelihood of developing a brain-disease like Alzheimer's in the future. No study was found which used the construct of response-efficacy in measuring intention towards behaviors related to Alzheimer's or dementia. Therefore, questions for response-efficacy were adopted from studies evaluating intentions using the Protection Motivation Theory (Wong, Gaston, DeJesus, and Prapavessis, 2016). Response-efficacy was measured using 2 items with responses measured on a 7-point Likert scale (1=strongly disagree to 7=strongly agree).

(iv) Self-efficacy: Belief that one can effectively undertake the recommended preventive measures to prevent their risk of development of Alzheimer's in the future. Questions for self-efficacy were adopted from previous studies using PMT in measurement of intentions (Norman et al., 2005; Wong et al., 2016). Self-efficacy was measured using 4 items with responses measured on a 7-point Likert scale (1=strongly disagree to 7=strongly agree).

(v) Intention: Intention to take the suggested preventive action was measured using a single item. The responses were measured on a 7-point Likert scale (1=strongly disagree to 7=strongly agree).

In addition to the above, the survey instrument also contained questions on demographic information, general health status and health literacy level. The demographic and other co-variables measured were age, gender, race/ethnicity, education, living situation, religious beliefs (2-questions), expectation regarding aging (ERA) (5-questions), general

health status, past-experiences and knowledge about Alzheimer's or other brain-diseases, past-experiences and knowledge about preventive behaviors for cognitive health, and finally a self-reported cognitive screening measure (8-questions) was included.

### **Manipulation Checks**

The manipulated variables in this study were message framing and involvement.

Manipulation for the involvement was measured using 5-point semantic scale where 1=Not at all Motivated to 5=Extremely Motivated. Manipulation for framing was measured using 4 questions: (i) The ad made me feel worried about the bad things that can happen due to a brain-disease like Alzheimer's; (ii) The ad made me feel disturbed and troubled; (iii) The ad made me feel happy about my brain-health; and (iv) The ad gave me a feeling of comfort and hope. The respondents were asked to indicate their responses on a 5-point scale from 1=Not at all to 5=Extremely.

### **Instrument Development and Pilot Testing**

The study instrument was developed using the online-software system Qualtrics.

Qualtrics software enables collection and analysis of data for different purposes via an internet-based access system. Due to the specific nature of the population desired (40-60 years of age), Qualtrics was considered as a platform which would enable and aid in accessing a larger and diverse community of the desired population group. The survey was built using the online-platform and was tested for ease of use, response time, and readability using pilot studies. The pilot studies were conducted as a replica of the experiment to determine the logistics and gather information that can improve the quality and efficiency of the questionnaire. The following pilot study protocol was adopted (Peat, 2001):

- Administer questionnaire to pilot subjects in exactly the same way as it will be
- administered in the main study
- Subjects be asked for feedback to identify ambiguities and difficult questions
- Time taken to complete the questionnaire be recorded
- Discard all unnecessary, difficult or ambiguous questions
- Assess whether each question gives an adequate range of responses
- Establish that replies can be interpreted in terms of the information that is required
- Check that all questions are answered
- Re-word or re-scale any questions that are not answered as expected
- Shorten, revise and, if possible, pilot again

A total of 5 pilot studies were conducted. The first pilot test was conducted using 6 responses. However, a number of concerns with the survey design were observed, for example the involvement scenarios did not produce the desired manipulation effect, size and clarity of the font for the manipulations created, content of the framing manipulations among others. After repeated revisions and addressing all the difficulties with the on-line survey, a final pilot study was conducted using 8 participants. The results of the pilot study produced satisfactory responses and the survey was thus finalized.

Online internet based surveys provide several advantages such as gaining access to a difficult to access demographic, time-saving, cost-saving due to the use of an electronic format as compared to paper-format(Ellison, Steinfield, and Lampe, 2007). At the same time, internet based surveys have the drawbacks such as unknown sample characteristics, reliability of responses obtained, incomplete data among others. However, the survey

instrument was so designed to capture as much data regarding the sample characteristics to ensure maximum authenticity. Quality checks were also introduced to ensure the appropriate sample is obtained. For e.g. a speeding check was added which terminated the survey if the respondents did not appear to answer to the questions thoughtfully. A soft-launch was also conducted to review any other concerns with the survey set-up.

### **Sample Selection and Experimental Procedure**

As indicated previously, the desired sample for the current study was adults aged 40-60 years of age. The desired age group was ensured by adding two quality checks: (i) The consent form included information that the survey was targeted for individuals 40-60 years of age; (ii) A quality check question was introduced in the beginning of the survey which asked the participants to indicate their year of birth. This quality check ensured that the participants younger than 40 years or older than 60 years were directed to the end of the survey with a message indicating that they were not eligible for the survey.

Following procedure was followed by Qualtrics for collection of the survey responses:

Participants were recruited through a number of ways including but not limited to:

Website intercept recruitment, Member referrals, Targeted email lists, Gaming Sites, Customer loyalty web portals, Permission-based networks, Social Media.

Participants were verified through a double-opt-in process and agreed to take part in surveys for an incentive. B2B participants were also verified through a double opt-in process, and were also subject to other quality control measures such as LinkedIn matching, phone calls made to the participant's place of business, and other third-party verification methods. (TrueSample, RelevantID, Varity, Etc.). Using profile information

provided by the participants, Qualtrics sent them specific email invitations to applicable surveys. If they elected to participate, panelists were informed and agreed at the beginning that they will only receive compensation upon completion of the survey. If they elected to stop before the survey was finished they were not compensated. Upon accepting the invitation, participants entered the survey instrument prepared by the Researcher and complete the survey.

### **Sample Size Determination**

To determine the sample size, an a priori power analysis was carried out by using the GPower statistical software, version 3.1. In a priori analysis, sample size N is computed as a function of the power required, the pre-specified significance level and the population effect size. It is an efficient method for controlling power before a study is actually conducted (Cohen, 1992; Faul, Erdfelder, Lang, and Buchner, 2007). While carrying out the analysis following 4 parameters are very important:

- a) Sample size, n
- b) Effect size, d
- c) Power
- d) Probability of Type 1 error/Significance level,  $\alpha$ .

Alpha ( $\alpha$ ) is the probability of making a type I error i.e. rejecting the null hypothesis when it is true. By setting an acceptable level of  $\alpha$ , this probability is controlled at the beginning of the experiment. Power is related to the type II error ( $\beta$ ) i.e. failing to reject the null hypothesis when it is false. Power is thus expressed as

$$\text{Power} = 1 - \beta$$

Thus, power refers to the ability of the test to reject the null hypothesis when it should be

rejected which in turn refers to the ability of that test to detect statistically significant differences (Agresti and Agresti, 1970). Effect size (d) refers to the expected difference between the groups being compared (Tran, 1997). The value of effect size for small, medium and large magnitude varies for different statistical tests. Each of the four parameters – alpha ( $\alpha$ ), effect size (d), power ( $1 - \beta$ ) and sample size (n) are inter-related. By knowing the value of any three of these parameters, the value of the fourth can be determined (Cohen, 1992). At a given value of first two, the only factor that can affect power is the sample size. If the sample size is too small the power of the statistical test will be too low to detect significant differences. On the other hand, if the sample size is very large, valuable time and resources are wasted, with minimal improvements in power (Hill, Lewicki, and Lewicki, 2006). Therefore, it is very important to have the most appropriate sample size so that, for a given  $\alpha$  and d, a sufficiently powerful design can be obtained without overuse of time and resources.

For the current study, repeated measures ANCOVA test was conducted. Following parameters were used to calculate the sample size: Effect size = 0.2 (small);  $\alpha$ -err probability = 0.05; Power = 0.95; Numerator DF=1; Number of groups = 18 [14 covariates + 4 groups (2X2 factorial)]; Number of covariates = 14. The analyses revealed a required sample size of 311.

## **Statistical Analyses**

### Reliability Analysis:

Reliability is defined as the extent to which a measure is accurate and consistent. The instrument in this study measured each variable using several items on a standardized five point scale. For the instrument to be reliable, it is important for all items in a domain



to be correlated with each other and to consistently measure the same thing. Reliability analyses were thus performed for all the constructs measured by calculating and reporting Cronbach's alpha.

Note, the survey questions were adopted from pre-validated questionnaire used in past. Hence, formal validity analyses are not required. However, content validity was test using expert judgments.

Calculation of Measured Constructs:

Perceived Severity (PS) = Score based on the patients' perception of the severity of a brain-disease like Alzheimer's. Total score was obtained as an average of all 3 questions.

$$PS = (ps1 + ps2 + ps3) \div 3$$

Perceived vulnerability (PV) = Score based on patients' perception of their own susceptibility to developing a brain disease like Alzheimer's in the future. Scores were obtained as follows:

$$PV = (pv1 + pv2 + pv3) \div 3$$

Response-efficacy (RE) = Score based on patients' perception regarding the effectiveness of the suggested preventive behaviors. Scores were obtained as follows:

$$RE = (re1 + re2) \div 2$$

Self-efficacy (SE) = Score based on patients' belief that they can successfully engage in the recommended preventive behaviors:

$$SE = (se1 + se2 + se3 + se4) \div 4$$

Intention to take preventive measures (I) = Score based on patients' readiness to take the recommended preventive measures immediately.

The data analysis process involved several methods. Frequency distributions and measures of central tendency and dispersions were used to describe the sample and participant responses on the survey instrument. Given the repeated nature of the experiment, repeated measures analysis (ANCOVA) was used to analyze the impact of message framing and involvement on measured variables. Post hoc analyses were conducted to determine which of the  $k$  means in a one-way ANOVA are significantly different. Statistical analyses were performed using SAS<sup>®</sup> Version 9.2 set at *a priori* significance level of 0.05.

### **Assumptions**

The methodology and results of this study were based on the following assumptions:

- 1) Human beings are rational and make systematic use of information available to them.(Ajzen, 1991)
- 2) People consider the implications of their actions before they decide to engage or not engage in certain behaviors.(Ajzen, 1991)
- 3) The participants understood the questionnaire and responses indicated by the participants on the questionnaire truly reflected their personal opinions.
- 4) Respondents provided accurate information about their socio-demographic and socio-economic characteristics.

## **CHAPTER 5: RESULTS**

The results of the study will be presented in this chapter. The chapter would be categorized in three broad sections. Section one will describe the details about the sample characteristics followed by section 2 on psychometric testing of the instrument, model adequacy and manipulation test results. Hypotheses testing of main effects of message framing and involvement and their interaction effects will be discussed in section 3.

### **Section 1 – Sample Characteristics:**

A-priori sample size calculations revealed that 350 completed surveys would be required to test the hypotheses. Data was collected from January 26, 2018 to February 01, 2018.

Data collection was accomplished using online-data collection software Qualtrics.

A total of 368 surveys were obtained at the end of the data collection.

A summary of demographic and sample characteristic is provided in Table 4-1a and Table 4-1b. The mean age of all respondents was 51.64 ( $\pm 5.48$ ) years. The sample has an equal distribution of males and females. Most of the participants indicated that they were extremely confident in filling out medical forms by themselves [n=178 (48.37%)] and never need help when reading material from their doctor or pharmacy [n=216 (58.7%)]. All respondents indicated that they at least had middle school education. Majority had some type of college education [n=192 (52.17%)]. Majority of the participants were white [n=298 (80.98%)]. Most of the participants lived with their spouse/partner [n=155 (42.12%)], while some others lived with children/family [n=106 (28.8%)], alone [n=103 (27.99%)] or in a care facility [n=4 (1.09%)]. A total of 54 (14.67%) participants did not have insurance while the others had either private (48.37%) or government (36.96%)

insurance. With respect to religious beliefs, a majority indicated that they never attended religious services [n=166 (45.11%)]. A total of 104 (28.26%) indicated that spirituality or religious faith was not at all important in making decisions about health while a considerable proportion indicated that it was extremely important [n=83 (22.55%)]. Most participants did not have any family member or friend with Alzheimer's or other brain-disease [n=281 (76.36%)].

**Table 4-1a: Descriptive statistics and Sample characteristics (n=368)**

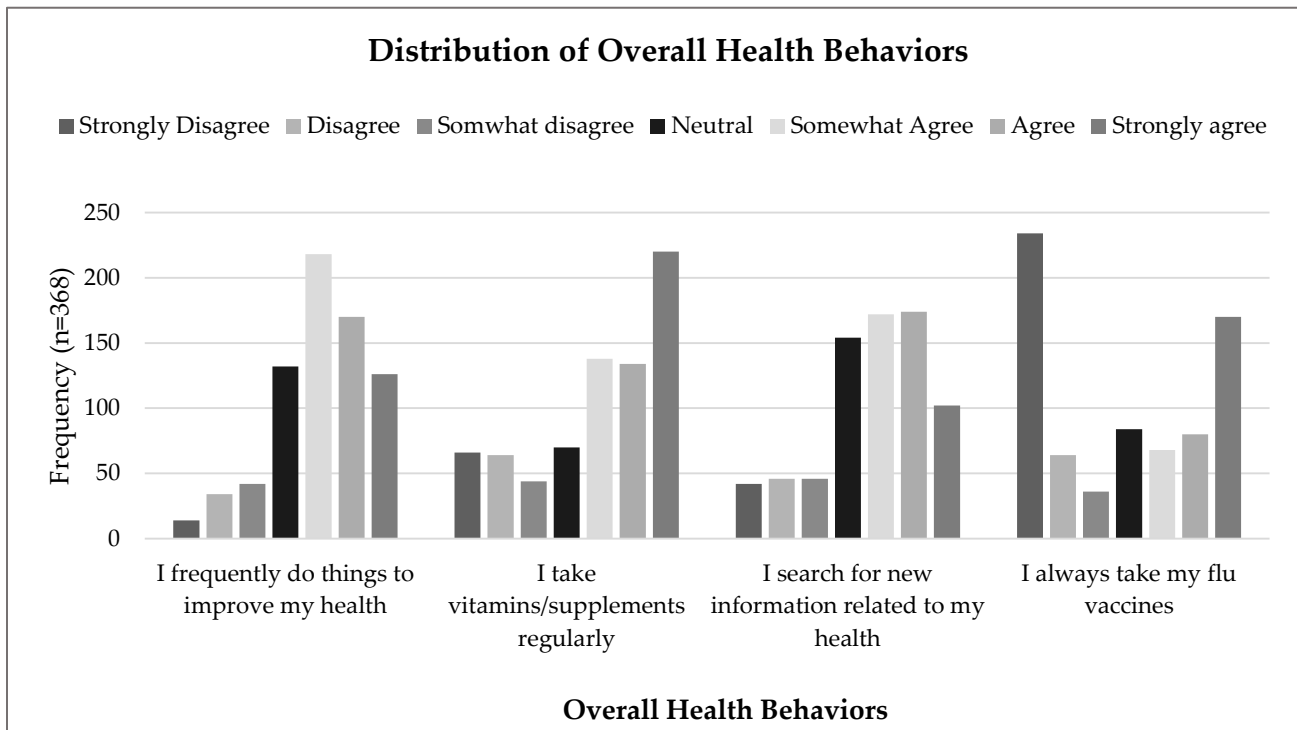
Variable	Means	SD	Min	Max
Age	51.64	5.48	42	60
Overall Health Behaviors	4.65	1.29	1	7
Expectation Regarding Aging	5.21	1.16	1	7

**Table 4-1b: Descriptive statistics and Sample characteristics (n=368)**

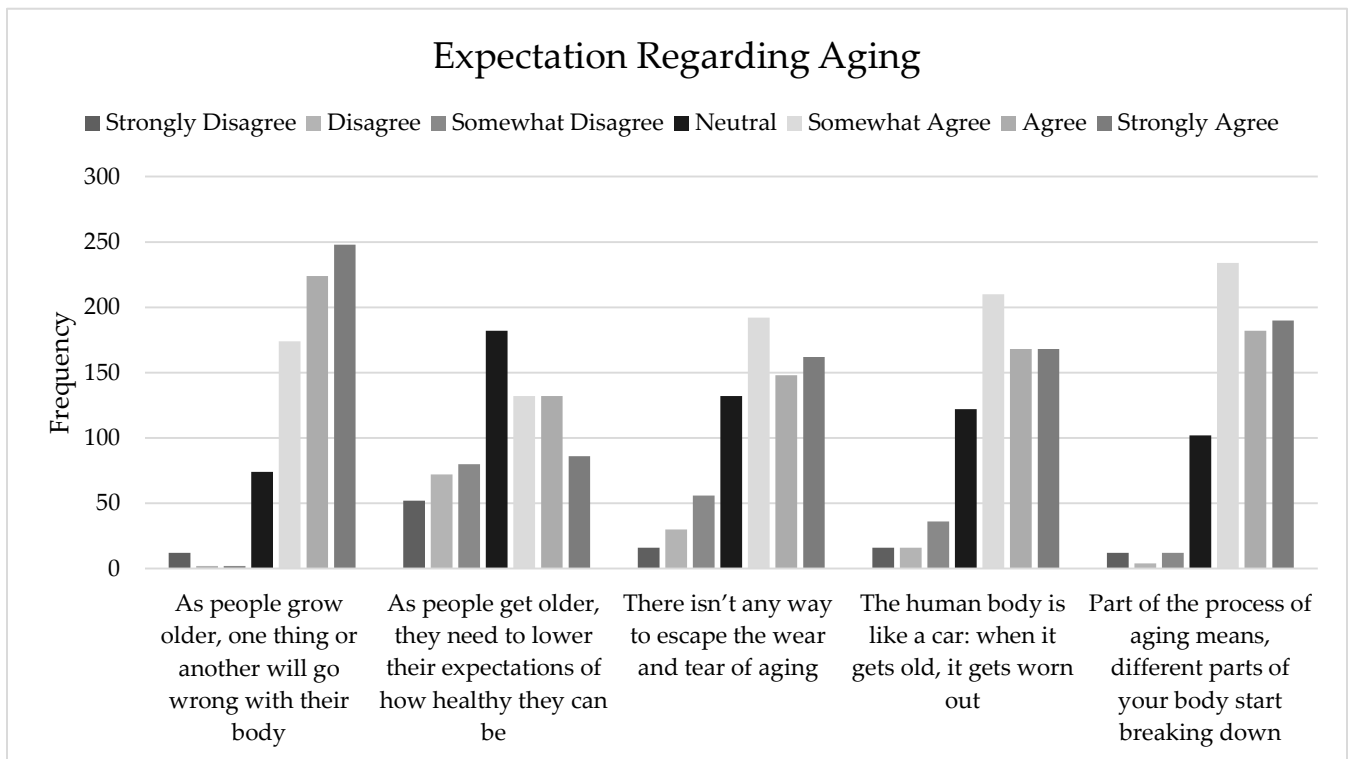
Variable		Frequency (%) (N=368)
<b>General Health Status</b>		
	Excellent	41 (11.14)
	Very Good	85 (23.1)
	Good	146 (39.67)
	Fair	80 (21.74)
	Poor	16 (4.35)
<b>Gender</b>		
	Male	184 (50)
	Female	184 (50)
<b>Health Literacy</b>		
How confident are you filling out medical forms by yourself?	Not at all (confident)	6 (1.63)
	A little bit	14 (3.8)
	Somewhat	66 (17.93)
	Quite a bit	104 (28.26)
	Extremely	178 (48.37)
How often do you need help when reading written material from your doctor or pharmacy?	Never	216 (58.7)
	Occasionally	66 (17.93)
	Sometimes	40 (10.87)
	Often	18 (4.89)
	Always	28 (7.61)

Education (highest level)		
	None	0 (0)
	Elementary	0 (0)
	Middle School	4 (1.09)
	High School	128 (34.78)
	College	192 (52.17)
	Masters	37 (10.05)
	Doctoral/PhD/Higher	7 (1.9)
Race/ethnicity		
	Asian	16 (4.35)
	Hispanic	12 (3.26)
	White (non-Hispanic)	298 (80.98)
	African-American	34 (9.24)
	Native American	3 (0.82)
	Others	5 (1.36)
Living situation		
	Partner/Spouse	155 (42.12)
	Children/Family	106 (28.8)
	Alone	103 (27.99)
	Care Facility	4 (1.09)
Insurance status		
	Private	178 (48.37)
	Government (Medicare/Medicaid)	136 (36.96)
	No Insurance	54 (14.67)
Religious beliefs		
How often do you usually attend religious services	Never	166 (45.11)
	Once a year	28 (7.61)
	A few times a year	56 (15.22)
	At least once a month	25 (6.79)
	At least once a week	73 (19.84)
	Nearly everyday	20 (5.43)
How important is your spirituality or religious faith to you in making decisions about health?	Not at all important	104 (28.26)
	Somewhat important	51 (13.86)
	Important	69 (18.75)
	Very important	61 (16.58)
	Extremely important	83 (22.55)
Family history/friends with Alzheimer's or other brain disease		
	Yes	87 (23.64)
	No	281 (76.36)

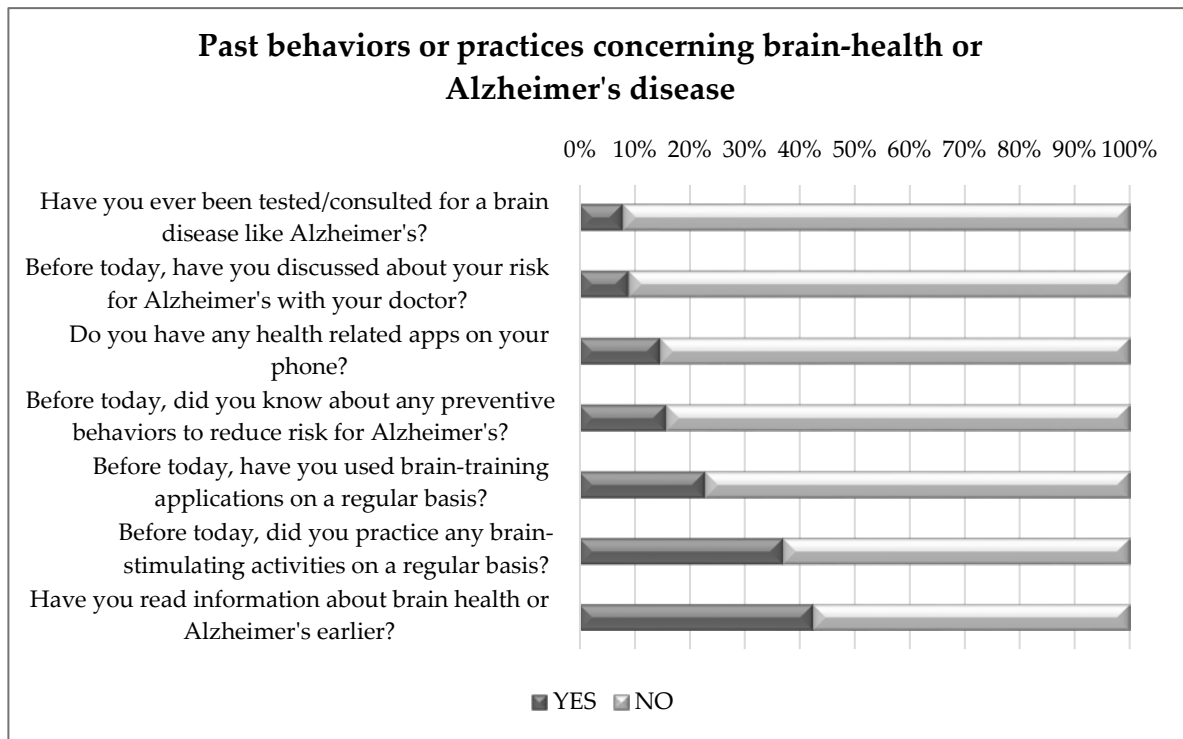
**Figure 5-1: Frequency distribution of participants' overall health behaviors.**



**Figure 5-2: Frequency distribution of participants' Expectations Regarding Aging.**



**Figure 5-3: Participants' past behaviors and characteristics concerning brain health.**





## **Section 2: Psychometric Testing - Reliability, Validity and Manipulation Checks**

### *Reliability Analysis*

Before a measure could be considered valid, it should be reliable. Reliability deals with the extent to which a measure is accurate and consistent. In other words, it is the ability of the survey or the questions to yield same results each time. Reliability can be tested using following methods:

- 1) Test-retest method – Same scale given at different times.
- 2) Alternate form method – two different scales measuring the same concept. One of the scales should be established as reliable and the other scale is the one which is to be tested.
- 3) Split-half method – Divide the scales and compare.
- 4) Internal Consistency method
  - a. Homogeneity of scale items – Cronbach's Alpha
  - b. Kuder-Richardson Method – Strictly for binary measures

For the current study Cronbach's alpha was considered as an appropriate method to test the reliability. Cronbach's alpha is an index of reliability associated with the variation accounted for by the true score of the "underlying construct." Its value can range from 0 to 1 and it indicates the internal consistency of the scale (Santos 1999). The higher the score, more reliable the generated scale is. For behavioral research, a value of 0.7 or above is acceptable but scales with lower threshold have been used in the literature (Nunnally 1978).

Reliability was tested for the measured variables specifically, perceived severity, perceived vulnerability, response-efficacy and self-efficacy. Since intention was

measured using one item, no coefficient was calculated. The correlation of each item in a domain with the total score for the domain was also determined.

**Table 4-2: Reliability analyses – Cronbach’s Alpha co-efficient calculated for each construct of the PMT model.**

Variable	Number of items	Reliability-Coefficient	P-value
Perceived severity	3	0.82	<0.0001
Perceived vulnerability	3	0.92	<0.0002
Self-efficacy	4	0.94	<0.0003
Response-efficacy <sup>a</sup>	2	0.86	<0.0004

<sup>a</sup>Pearson Correlation Co-efficient reported

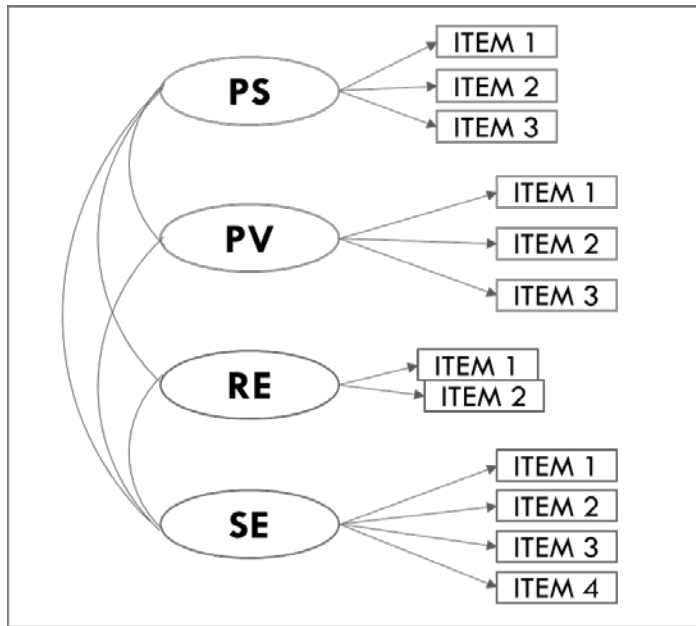
As indicated in the table above, all constructs had satisfactory reliability estimates.

#### *Validity Analysis:*

Validity refers to how well a test measures what it intends to.

- Content validity determines whether the content is representative of the whole concept. Expert judgments were considered for determining the content validity of the questionnaire.
- Construct validity determines the degree to which the items used to measure the construct actually measure what they claim. Since the items for each construct were adapted from different questionnaires and modified to suit the current study, confirmatory factor analysis (CFA) was conducted to test the fit of the proposed model structure. Figure 5-4 represents the model tested using CFA.

**Figure 5-4: Confirmatory Factor Analysis Results for Testing Model Fit for Protection Motivation Theory**



PS=Perceived severity, PV=Perceived vulnerability; RE=Response efficacy; SE=Self efficacy

The results of CFA indicated that all factor loadings for the proposed paths were significant. The standardized root mean square residual (SRMR) value for the model was 0.049. A value of SRMR < 0.08 is considered as an acceptable fit (Hooper, Coughlan, and Mullen, 2008). The comparative fit index (CFI) value for the model was 0.953. A CFI > 0.95 is considered as a good fit. Based on these two indices, it was concluded that the model had an acceptable fit.

#### *Manipulation check results*

Manipulation checks were conducted to identify whether the stimuli i.e. involvement and message framing were manipulated successfully. As explained in methodology single item was used for involvement and multiple-item measures were used for message framing. For manipulation check, the mean values were compared across the levels using

a t-test. The results showed a significant difference in means across the different levels indicating a successful manipulation. For message framing, means for each item as well as a composite mean score of all 4-items was compared across the two levels of message framing.

**Table 4-3: Manipulation check results using t-test to compare means across different levels of the manipulated variables.**

Stimuli	Conditions	Mean (±SD)	p-value
Involvement Level	Low	2.20 (1.24)	<.0001
	High	3.68 (1.19)	
Framing (total)	Positive	2.35 (1.29)	<.0001
	Negative	2.89 (1.33)	
Individual framing items			
The ad made me feel fearful and worried about the terrible things that Alzheimer's can cause	Positive	2.48 (1.34)	<.0001
	Negative	3.05 (1.40)	
The ad made me feel disturbed and troubled	Positive	2.21 (1.34)	<.0001
	Negative	2.73 (1.40)	
The ad made me feel happy about my brain-health	Positive	3.15 (1.32)	0.0652
	Negative	2.97 (1.36)	
The ad gave me a feeling of comfort and hope	Positive	3.23 (1.36)	<.0001
	Negative	2.78 (1.40)	

#### *Model adequacy assumptions and testing*

The analyses described in this chapter are mostly using parametric statistical tests. Before analyzing data with parametric statistical tests, data were evaluated to see if the assumptions of normality, homoscedasticity, and variable independence. However, it should be noted that both the t-test and the F-test are robust enough to stand moderate deviations from these theoretical assumptions. Also when sample sizes are equal across the groups and large even major deviations from the above-mentioned assumptions can

be tolerated (Zar 1984)

In this study the sample size was equal (368) across groups and the number was large (368 X 3). Residual analyses did not indicate any major deviations from normality, homoscedasticity and linearity assumptions. Normal probability plots, histograms and residual plots did not indicate any violation of model adequacy assumptions. Data transformation was not necessary. Hence only parametric tests were used to report examined hypothesis.

### **Section 3 – Statistical hypotheses testing**

#### *Method 1: Using Framing and Involvement as dichotomous independent variables*

Results of MANOVA will be presented to test for hypothesis H1, H2 and H3. In other words MANOVA will help identify the effect (overall main effects and interaction effect) of cognitive effort and involvement on outcome variables specifically information load, information anxiety, product knowledge, attitude towards the leaflet and intention to read. Null Hypothesis (H<sub>0</sub>) – There is no significant difference between the scores of information load, information anxiety, product knowledge, attitude towards the leaflet and intention to read across the 3 different leaflet and two levels of involvement. Table 4 shows the result for MANCOVA.

**Table 4-4: Test for hypothesis of no overall effect of message framing and involvement on dependent variables of the PMT model.**

<b>Variable</b>	<b>Wilk's Lambda</b>	<b>F - Value</b>	<b>Pr &gt; F</b>
Message framing	0.99702122	0.43	0.8311
Involvement	0.96548968	5.09	0.0001
Message framing*Involvement	0.99057982	1.35	0.2397
General Health Status	0.99692693	0.44	0.8214
Overall Health Behaviors	0.93879924	9.28	<.0001
Age	0.9768661	3.37	0.0051

Health Literacy	0.95240963	7.12	<.0001
Education	0.97574862	1.76	0.0635
Gender	0.98309559	2.45	0.0326
Race/Ethnicity	0.96693005	4.87	0.0002
Insurance	0.99335358	0.95	0.4461
Expectation Regarding Aging	0.83446783	28.25	<.0001
Religious Beliefs	0.97371414	3.84	0.0019
Family history	0.94134478	8.87	<.0001
Health Applications Use	0.98683495	1.9	0.0922
Past consultation	0.96407106	2.63	0.0036
Past behaviors	0.86512473	22.2	<.0001

Post MANCOVA, ANCOVA tests were conducted to determine the effects of independent variables on each of the dependent variables. Results of ANCOVAs are discussed in sections below. Only significant results are reported in the following tables.

i) Effect of Message Framing and Involvement on Perceived Severity

H<sub>0</sub>: There is no statistically significant difference in perceived severity scores between the levels of message framing and involvement.

The results indicated that message framing and involvement did not have significant direct effect on perceived severity.

**Table 4-5: ANCOVA to evaluate the effect of message framing and involvement on mean scores of perceived severity.**

Source	DF	Type III SS	Mean Sq.	F value	Pr > F
<b>Involve</b>	1	0.392663	0.392663	0.24	0.6229
<b>Framing</b>	1	0.8044988	0.8044988	0.5	0.4816
<b>Involve*Framing</b>	1	3.9535445	3.9535445	2.44	0.119
<b>Gender (female)</b>	1	13.3161811	13.3161811	8.21	0.0043
<b>Age (≥50)</b>	1	8.6985429	8.6985429	5.36	0.0209
<b>General health behaviors</b>	1	25.4904977	25.4904977	15.71	<.0001
<b>Religious beliefs (important)</b>	1	7.138745	7.138745	4.4	0.0363
<b>Expectation regarding aging</b>	1	180.6166908	180.616691	111.33	<.0001

<b>History of Alzheimer's or Brain disease</b>	1	51.3757804	51.3757804	31.67	<.0001
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ii) Effect of Message Framing and Involvement on Perceived Vulnerability

H<sub>0</sub>: There is no statistically significant difference in perceived vulnerability scores between the levels of message framing and involvement.

The results indicated that message framing did not have significant direct effect on perceived vulnerability, while involvement had a significant positive association with perceived vulnerability. High involvement was associated with higher scores for perceived vulnerability as compared to low involvement.

**Table 4-6: ANCOVA to evaluate the effect of message framing and involvement on mean scores of perceived vulnerability.**

Source	DF	Type III SS	Mean Sq.	F value	Pr > F
<b>Involve</b>	1	28.6980676	28.6980676	14.06	0.0002
<b>Framing</b>	1	0.6576087	0.6576087	0.32	0.5705
<b>Involve*Framing</b>	1	1.043286	1.043286	0.51	0.475
<b>Health Literacy</b>	1	35.1161849	35.1161849	17.2	<.0001
<b>Education</b>	2	12.3712495	6.1856247	3.03	0.049
<b>Expectation regarding aging</b>	1	125.257297	125.257297	61.35	<.0001
<b>Race (White)</b>	1	11.4992387	11.4992387	5.63	0.0179
<b>Religious Beliefs</b>	1	10.0920837	10.0920837	4.94	0.0265
<b>Past test/discussion with doctor</b>	1	48.5729627	48.5729627	24.2864814	<.0001
<b>Past behaviors</b>	1	49.1157412	49.1157412	24.06	<.0001
<b>Family History of Alzheimer's or Brain disease</b>	1	57.231111	57.231111	28.03	<.0001

**Table 4-7: Least Square Means for the effect of Involvement on Perceived Vulnerability**

Variable	LSMean	Pr > F
Low Involvement	4.14	0.0002
High Involvement	4.53	

iii) Effect of Message Framing and Involvement on Self-efficacy

H<sub>0</sub>: There is no statistically significant difference in self-efficacy scores between the levels of message framing and involvement.

The results indicated that message framing and involvement did not have significant main effects on self-efficacy. However, framing and involvement showed significant interaction effects on self-efficacy.

**Table 4-8: ANCOVA to evaluate the effect of message framing and involvement on mean scores of self-efficacy.**

Source	DF	Type III SS	Mean Sq.	F value	Pr > F
<b>Involve</b>	1	0.70320992	0.70320992	0.41	0.5223
<b>Framing</b>	1	0.90090014	0.90090014	0.52	0.469
<b>Involve*Framing</b>	1	9.67320738	9.67320738	5.64	0.0179
<b>Age (≥50)</b>	1	10.7984012	10.7984012	6.29	0.0123
<b>General health behaviors</b>	1	40.82449506	40.8244951	23.79	<.0001
<b>Religious beliefs</b>	1	16.03130589	16.0313059	9.34	0.0023
<b>Expectation regarding aging</b>	1	26.21870433	26.2187043	15.28	0.0001
<b>Past behaviors</b>	1	69.90963173	69.9096317	40.74	<.0001



iv) Effect of Message Framing and Involvement on response efficacy

H<sub>0</sub>: There is no statistically significant difference in response efficacy scores between the levels of message framing and involvement.

The results indicated that message framing and involvement did not have significant direct effect on response efficacy.

**Table 4-9: Least Square Means for the effect of Involvement on mean scores of response-efficacy**

Source	DF	Type III SS	Mean Sq.	F value	Pr > F
<b>Involve</b>	1	1.30570652	1.30570652	0.69	0.4076
<b>Framing</b>	1	0.59918478	0.59918478	0.32	0.5748
<b>Involve*Framing</b>	1	5.32025116	5.32025116	2.8	0.0949
<b>General health behaviors</b>	1	59.35906889	59.3590689	31.21	<.0001
<b>Race (White)</b>	1	20.63615823	20.6361582	10.85	0.001
<b>Religious beliefs</b>	1	23.0675818	23.0675818	11.87	0.0006
<b>Expectation regarding aging</b>	1	18.53178279	18.5317828	9.74	0.0019
<b>Religious beliefs</b>	1	20.17258693	20.1725869	10.61	0.0012
<b>Past behaviors</b>	1	40.73117356	40.7311736	21.42	<.0001

v) Effect of Message Framing and Involvement on Intention

H<sub>0</sub>: There is no statistically significant difference in intention scores between the levels of message framing and involvement.

The results indicated that message framing did not have significant direct effect on intention, while involvement had a significant positive association with intention.

High involvement was associated with higher scores for intention as compared to low involvement.

**Table 4-10: ANCOVA to evaluate the effect of message framing and involvement on mean scores of intention.**

Source	DF	Type III SS	Mean Sq.	F value	Pr > F
<b>Involve</b>	1	20.2228261	20.2228261	9.07	0.0027
<b>Framing</b>	1	0.048913	0.048913	0.02	0.8823
<b>Involve*Framing</b>	1	4.3164385	4.3164385	1.91	0.1678
<b>Gender</b>	1	10.8143187	10.8143187	4.85	0.0279
<b>General health behaviors</b>	1	83.8535054	83.8535054	37.63	<.0001
<b>Health Literacy</b>	1	9.7899113	9.7899113	4.39	0.0364
<b>Religious beliefs</b>	1	40.0822797	40.0822797	17.7	<.0001
<b>Expectation regarding aging</b>	1	15.6362338	15.6362338	7.02	0.0083
<b>Past behaviors</b>	1	109.0501698	109.05017	48.94	<.0001
<b>Family History of Alzheimer's or brain disease</b>	1	11.6891626	11.6891626	5.25	0.0223

*Method 2: Using Framing and Involvement as continuous independent variables*

This method of hypotheses testing is based on conceptualization by O'Keefe concerning effects of persuasive message variations on intended outcomes.(O'Keefe, 2003)

According to this conceptualization, message variations make up for variations in certain psychological states, which in turn influence the intended outcomes which are sought after. Often times, such psychological states are used as manipulation checks and thus, the message properties are not adequately assessed.

In order to test the effects of framing and involvement using the claims by O'Keefe, alternate analyses were conducted using manipulation check scores for framing and involvement as continuous primary independent variables. Multiple linear regression

analyses were conducted to test the main effects as well as interaction effects for framing, while adjusting for the covariates. Following tables present the results for the various regression models.

Note: Only significant covariates are reported in the tables below.

i) Effect of framing and involvement on perceived severity

H0: There is no statistically significant association between scores for message framing and involvement on perceived severity.

**Table 4-11: Multiple Linear Regression Analysis for the effect of message framing and involvement on perceived severity.**

Variable	Parameter Estimate	Standard Error	t Value	Pr >  t
Involvement	0.2216	0.11175	1.98	0.0478
Framing	0.3779	0.13107	2.88	0.0041
Interaction	-0.01476	0.03836	-0.38	0.7006
Overall Health Behaviors	0.15295	0.03931	3.89	0.0001
Age	0.28136	0.09747	2.89	0.004
Gender	0.3232	0.09317	3.47	0.0006
Expectation Regarding Aging	0.40413	0.04138	9.77	<.0001
Family history	-0.59321	0.11431	-5.19	<.0001
Past behaviors	0.29094	0.12082	2.41	0.0163

ii) Effect of framing and involvement on perceived vulnerability

H0: There is no statistically significant association between scores for message framing and involvement on perceived vulnerability.

**Table 4-12: Multiple Linear Regression Analysis for the effect of message framing and involvement on perceived vulnerability.**

<b>Variable</b>	<b>Parameter Estimate</b>	<b>Standard Error</b>	<b>t Value</b>	<b>Pr &gt;  t </b>
<b>Involvement</b>	0.27077	0.12588	2.15	0.0318
<b>Framing</b>	0.50363	0.14764	3.41	0.0007
<b>Interaction</b>	-0.02536	0.0432	-0.59	0.5574
<b>Health Literacy</b>	-0.13506	0.04714	-2.87	0.0043
<b>Race/Ethnicity</b>	0.27187	0.1331	2.04	0.0415
<b>Expectation Regarding Aging</b>	0.31896	0.04661	6.84	<.0001
<b>Family history</b>	-0.66558	0.12876	-5.17	<.0001
<b>Past consultation</b>	-1.00491	0.24956	-4.03	<.0001
<b>Past behaviors</b>	-0.59035	0.1361	-4.34	<.0001

iii) Effect of framing and involvement on response-efficacy

H0: There is no statistically significant association between scores for message framing and involvement on response-efficacy.

**Table 4-13: Multiple Linear Regression Analysis for the effect of message framing and involvement on response efficacy.**

<b>Variable</b>	<b>Parameter Estimate</b>	<b>Standard Error</b>	<b>t Value</b>	<b>Pr &gt;  t </b>
Involvement	0.23254	0.12016	1.94	0.0533
Framing	-0.262	0.14093	-1.86	0.0634
Interaction	0.01094	0.04124	0.27	0.7908
Overall Health Behaviors	0.19417	0.04226	4.59	<.0001
Education	-0.20543	0.08174	-2.51	0.0122

Race/Ethnicity	-0.44598	0.12705	-3.51	0.0005
Expectation Regarding Aging	0.10353	0.04449	2.33	0.0202
Religious Beliefs	0.07852	0.03718	2.11	0.035
Cognitive Status	-0.33067	0.15867	-2.08	0.0375
Past behaviors	0.51592	0.12991	3.97	<.0001

ii) Effect of framing and involvement on perceived self-efficacy

H0: There is no statistically significant association between scores for message framing and involvement on self-efficacy.

**Table 4-14: Multiple Linear Regression Analysis for the effect of message framing and involvement on self efficacy.**

Variable	Parameter Estimate	Standard Error	t Value	Pr >  t
Involvement	0.07156	0.11405	0.63	0.5306
Framing	-0.41504	0.13377	-3.1	0.002
Interaction	0.051	0.03915	1.3	0.193
Overall Health Behaviors	0.14917	0.04012	3.72	0.0002
Age	0.27598	0.09947	2.77	0.0057
Health Literacy	0.11273	0.04271	2.64	0.0085
Expectation Regarding Aging	0.13001	0.04223	3.08	0.0022
Religious Beliefs	0.10286	0.03529	2.91	0.0037
Cognitive Status	-0.39895	0.15061	-2.65	0.0083
Past behaviors	0.69519	0.12331	5.64	<.0001

ii) Effect of framing and involvement on perceived intention

H0: There is no statistically significant association between scores for message framing and involvement on intention.

**Table 4-15: Multiple Linear Regression Analysis for the effect of message framing and involvement on intention.**

<b>Variable</b>	<b>Parameter Estimate</b>	<b>Standard Error</b>	<b>t Value</b>	<b>Pr &gt;  t </b>
<b>Involvement</b>	0.50293	0.1289	3.9	0.0001
<b>Framing</b>	0.03349	0.15118	0.22	0.8247
<b>Interaction</b>	-0.04558	0.04424	-1.03	0.3033
<b>Overall Health Behaviors</b>	0.22057	0.04534	4.86	<.0001
<b>Age</b>	0.2992	0.11242	2.66	0.008
<b>Education</b>	-0.18805	0.08769	-2.14	0.0323
<b>Gender</b>	0.266	0.10746	2.48	0.0135
<b>Race/Ethnicity</b>	-0.25356	0.13629	-1.86	0.0632
<b>Religious Beliefs</b>	0.12066	0.03989	3.03	0.0026
<b>Family history</b>	-0.26614	0.13185	-2.02	0.0439

*Testing association between protection motivation theory model constructs.*

H0: There is no association between perceived severity, perceived vulnerability, response-efficacy and self-efficacy with intention to engage in preventive behaviors towards maintenance of a healthy brain

**Table 4-16: Multiple Linear Regression Analysis for the effect of Perceived Severity, Perceived Vulnerability, Self-efficacy and Response-efficacy on Intention**

<b>Variable</b>	<b>DF</b>	<b>Parameter estimate</b>	<b>Standard Error</b>	<b>t Value</b>	<b>Pr &gt;  t </b>
<b>Intercept</b>	<b>1</b>	-1.055	0.52124	-2.02	0.0433
<b>Perceived Severity</b>	<b>1</b>	0.15688	0.03215	4.88	<.0001
<b>Perceived Vulnerability</b>	<b>1</b>	0.09893	0.02678	3.69	0.0002
<b>Self-efficacy</b>	<b>1</b>	0.22867	0.04631	4.94	<.0001
<b>Response-efficacy</b>	<b>1</b>	0.55233	0.04467	12.36	<.0001
<b>Overall Health Behaviors</b>	<b>1</b>	0.08269	0.03069	2.69	0.0072
<b>Health Literacy</b>	<b>1</b>	-0.09042	0.03286	-2.75	0.0061
<b>Expectation Regarding Aging</b>	<b>1</b>	-0.095	0.03489	-2.72	0.0066
<b>Religious Beliefs</b>	<b>1</b>	0.19121	0.08411	2.27	0.0233
<b>Health Applications Use</b>	<b>1</b>	0.29627	0.11079	2.67	0.0077
<b>Past behaviors</b>	<b>1</b>	0.52279	0.09964	5.25	<.0001

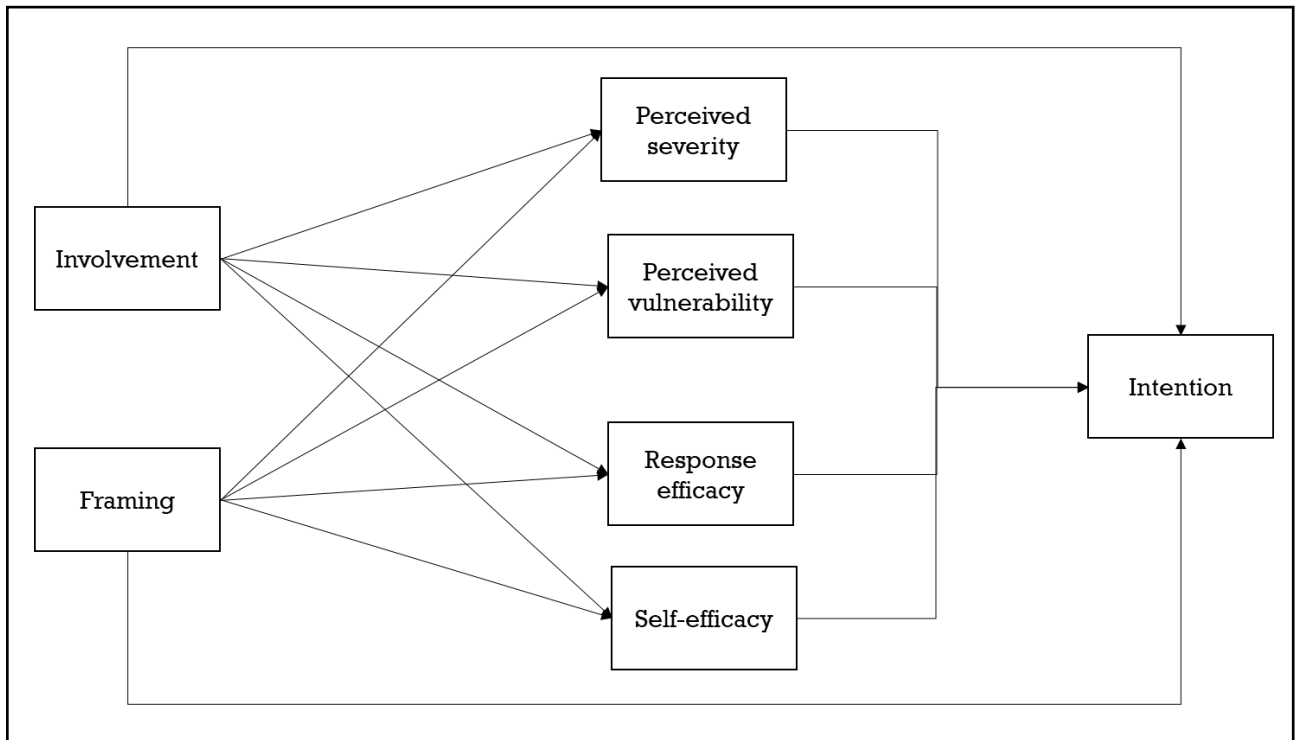
The results indicated that all constructs of PMT were positively associated with intention to engage in preventive behaviors.

#### Section 4: Path Analysis

This section would present the results of evaluating the comprehensive model. The test was conducted using the concept and methodology of structural equation modeling.

Mplus was used to test the proposed research model. The repeated nature of the study was taken into account by correlating data across different levels. Stand-alone fit statistics CFI, and SRMR were used to determine the adequacy of the proposed model. Figure 5-5 represents the result of the model testing.

**Figure 5-5: Path Analysis Model for the effect of Involvement and Framing on constructs of Protection Motivation Theory (original proposed model)**



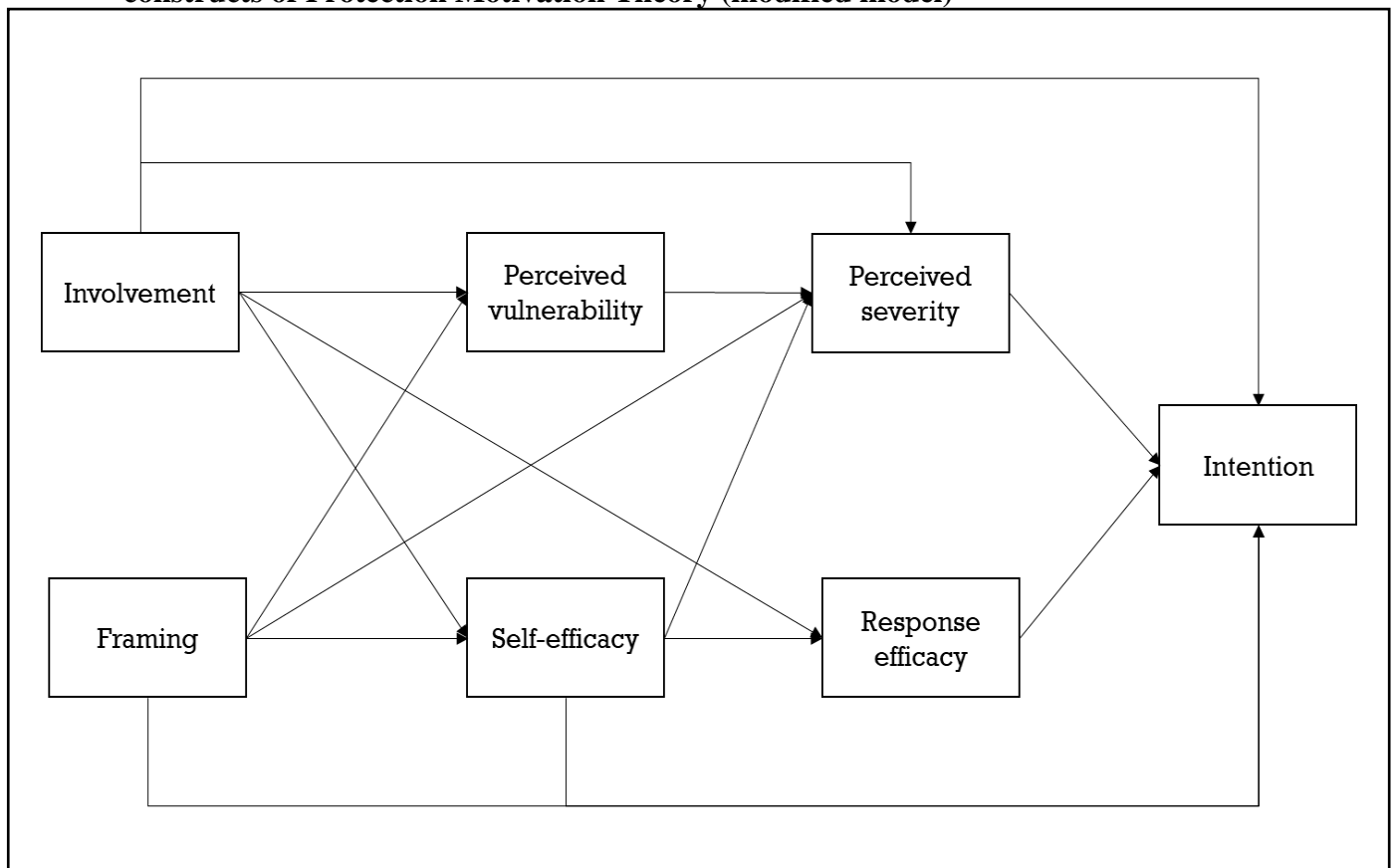
It was observed that although the proposed paths were significant, the model fit indices indicated a poor fit (CFI = 0.566; SRMR = 0.183).

Acceptable fit indices are CFI value >0.9 and SRMR<0.08.



The poor model fit estimates were likely due to some mediation effects between the factors in the model. After careful consideration, the following mediation model was proposed (Figure 5-6). The new proposed model had an acceptable fit (CFI = 0.973; SRMR = 0.051).

**Figure 5-6: Path Analysis Model for the effect of Involvement and Framing on constructs of Protection Motivation Theory (modified model)**



\*Only significant paths are displayed.

Table 4-17 summarizes the significant direct and indirect effect estimates for the revised path model

**Table 4-17: Direct and Indirect effects of Involvement and Framing on constructs of Protection Motivation Theory.**

<b>Independent Variable</b>	<b>Dependent Variable</b>	<b>Effects</b>
<b>Involvement</b>	Perceived Severity	Direct = 0.096; Indirect = 0.180; Total = 0.276
	Perceived Vulnerability	Direct = 0.278; Indirect = 0; Total = 0.276
	Response-efficacy	Direct = 0; Indirect = 0.132; Total = 0.132
	Self-efficacy	Direct = 0.266; Indirect = 0; Total = 0.266
	Intention	Direct = 0.144; Indirect = 0.251; Total = 0.395
<b>Framing</b>	Perceived Severity	Direct = 0.176; Indirect = 0.027; Total = 0.203
	Perceived Vulnerability	Direct = 0.259; Indirect = 0; Total = 0.259
	Response-efficacy	Direct = 0; Indirect = -0.128; Total = -0.128
	Self-efficacy	Direct = -0.172; Indirect = 0; Total = -0.172
	Intention	Direct = 0; Indirect = -0.058; Total = -0.058

## **Section 5: Study Hypotheses**

This section discusses the research hypotheses based on the results from regression analyses and path analyses

H1: There is an effect of involvement on constructs of Protection Motivation Theory

### Test results:

The study results support hypothesis that involvement has a significant effect on perceived severity [H1a], perceived vulnerability [H1b], on response-efficacy [H1c], self-efficacy [H1d] and intention [H1e] to engage in preventive behaviors.

Path analyses further indicated that involvement had a direct effect on perceived vulnerability and self-efficacy while the total effect of involvement on perceived severity, response efficacy and intention was a sum of direct + indirect effects.

H2: There is an effect of framing on constructs of Protection Motivation Theory

### Test results:

The study results support hypothesis that framing has a significant effect on perceived severity [H1a], perceived vulnerability [H1b], on response-efficacy [H1c], self-efficacy [H1d] and intention [H1e] to engage in preventive behaviors.

Path analyses further indicated that framing had a direct effect on perceived vulnerability and self-efficacy, while the effect on perceived severity was a sum of direct + indirect effects. The effect of framing on response-efficacy and intention were mediated (i.e. indirect) via perceived severity, perceived vulnerability and self-efficacy.

H3: There is an interaction effect of involvement and message-framing on constructs of Protection Motivation Theory

Test results:

The study results reject the hypothesis H3. There is no interaction effect between involvement and framing.

H4: There is an association between perceived severity, perceived vulnerability, response-efficacy and self-efficacy with intention to engage in preventive behaviors towards maintenance of a healthy brain

Test results:

The study results support the hypothesis H4. Perceived severity, perceived vulnerability, response efficacy and self-efficacy had a significant effect on intention to engage in preventive behaviors.

Path analysis further revealed that perceived severity and response-efficacy had a direct effect on intention, self-efficacy had a direct as well as indirect effect and perceived vulnerability had only an indirect effect on intention.

## **CHAPTER 5**

### **DISCUSSION, RECOMMENDATION AND CONCLUSIONS**

The aim of the study was to evaluate the effects of involvement and message framing on constructs of protection motivation theory namely, perceived severity, perceived vulnerability, response-efficacy, self-efficacy and intention in the context of engaging in preventive behaviors for cognitive health maintenance. This chapter begins with a discussion of the results followed by real-world implications, strengths and limitations of the study along with recommendations for future research.

Following the logical order, the discussion starts with the results of the demographic characteristics of the population and other extraneous variables. Further, the discussion emphasizes on the results of the experimental manipulation of primary independent variables of involvement and message framing on the dependent variables. The chapter concludes with a discussion of limitations and recommendations for future research.

#### **Demographic characteristics and extraneous variables**

The mean age of the study sample was 51 years with a range of 40 – 60 years, thus making it applicable to cognitively healthy older adults, based on definitions used in literature as well as expert opinions. The average age diagnosis (or symptom manifestation) of cognitive disorders like Alzheimer's disease has been reported to be 65 years or older (Alzheimer's Association, 2017). At the same time, clinical studies have suggested that neuropathological changes that cause Alzheimer's disease begin about 10-20 years of symptom manifestation (Beason-Held et al., 2013). Therefore the age group of 40-60 years is often considered as an appropriate group to initiate primary and secondary interventions to bring about behavioral changes.

There was an equal distribution of males and females. Effect of gender was observed only on intention to engage in preventive behaviors. Gender did not have an effect on other constructs of the protection motivation theory. Prior studies evaluating perceptions or behaviors in the context of Alzheimer's disease have reported that females have greater perception of developing AD in the next 10 years (Chung, Mehta, Shumway, Alvidrez, and Perez-Stable, 2009) and also were more likely to take a test for AD (Wikler, Blendon, and Benson, 2013). Although these differences were not found to be statistically significant.

Health literacy was found to have significant effect on self-efficacy. The study indicated that 42% of the sample had low health literacy (defined as needing help when reading written material from doctor or pharmacy). The results indicated that higher health literacy was associated with higher self-efficacy. Studies of self-care behavior in other disease areas such as diabetes and colorectal cancer screening have reported similar results indicating that higher health literacy is associated with greater self-efficacy (Bohanny et al., 2013; Von Wagner, Semmler, Good, and Wardle, 2009). These findings suggest the need for general education among older adults which enables them to read and understand health information obtained from various resources.

With regards to racial and ethnic distribution, majority of the respondents were Whites. It was observed that as compared to other race/ethnicities, Whites had greater perceptions of vulnerability and lower perceptions of response-efficacy. Prior studies evaluating racial and ethnic differences have reported that Whites had greater knowledge/perception of knowledge about Alzheimer's disease (L. A. Anderson et al., 2009) (Connell et al., 2007; Roberts et al., 2003). Although the current study did not measure knowledge about

AD, greater knowledge among Whites about AD as reported by prior studies may correlate to better understanding of risk of AD with age and thus higher perceptions of vulnerability among the older adults. At the same time, increased knowledge about AD causes and sub-par treatment effects may result to skepticism about the effects of behavioral measures for prevention, therefore leading to lower scores on response-efficacy. Future studies evaluating the effect of knowledge among different racial and ethnic backgrounds on perceptions and behavioral intentions are warranted.

Among the extraneous variables, lower expectations regarding aging successfully was significantly associated with greater perceived severity, perceived vulnerability, self-efficacy and response-efficacy. Lower expectations regarding aging was defined as beliefs such as ‘things will go wrong with the body as age increases’, ‘one needs to lower expectations as one grows old’ and ‘body breaks down as one grows old’. These findings are somewhat inconsistent with prior literature which indicated that lower expectations regarding aging was associated with not believing it is important to seek healthcare (Sarkisian, Hays, and Mangione, 2002).

With regards to religious beliefs, it was observed that a large proportion of older adults considered their religious faith and spirituality as important in making decisions about health. Having a higher score on religious beliefs was associated with higher response-efficacy, self-efficacy and intention to engage in preventive behaviors. Very few studies in the past have studied the influence of religious beliefs and spirituality in the context of Alzheimer’s disease and further research is warranted.

Past behaviors were recorded as any prior use of brain-training applications or engagement in mentally stimulating activities and was reported among 20-40% of the

respondents. Past behaviors were significantly associated with increased perception of severity, response-efficacy and self-efficacy and lower perception of vulnerability.

Although no direct effect on intention was observed. It may be assumed that past engagement in preventive behaviors may have been due to increased perceptions of severity of the condition. At the same time, prior engagement in prevention may instill the beliefs of less likelihood of developing Alzheimer's or brain diseases in the future. On similar grounds, it is intuitive that prior engagement in preventive behaviors may have been due to beliefs in the effectiveness of recommended preventive actions and may result in increased self-efficacy in future engagement. These findings suggest that it may encouraging initiation of preventive behaviors may lead to increased intentions for future engagement and long-term commitment. Future studies evaluating such effects are thus warranted.

Family history of Alzheimer's or other brain diseases was associated with decreased perceptions of severity and vulnerability towards Alzheimer's disease and decreased intention to engage in preventive behaviors. These results may suggest that individuals who have had close interactions with Alzheimer's patients may exhibit avoidance tendencies towards the disease, as indicated by the lower perceptions of severity and vulnerability and lower intentions to engage in protective behaviors for themselves.

### **Effect of Involvement and Framing**

#### **a) Effect on threat appraisal: perceived severity and perceived vulnerability**

It was observed that involvement and framing had a positive and significant effect on perception of severity of Alzheimer's disease and perceived vulnerability. A higher level of involvement i.e. personal relevance to the condition may have led to increased



understanding of the impact of the disease on lives and hence lead to an increased perception of severity. The effect of involvement remained constant regardless of how the information was presented. There was no interaction between involvement and framing. Similarly, a higher score on framing was associated with increased perceptions of severity and vulnerability. These results are consistent with prior framing literature which indicates that negative framing of information is associated with increased threat appraisal (Maheswaran and Meyers-Levy, 1990; Meyers-Levy and Maheswaran, 2004; Rothman et al., 1993). Greater levels of fear should be aroused if an individual perceives him or herself to be vulnerable to a serious health threat and this will increase an individual's motivation to engage in protective behavior.

b) Effect on coping appraisal: response-efficacy and self-efficacy

The literature on fear appeals suggests that a greater sense of threat might increase persuasiveness, but only if recipients feel capable of avoiding the threat (Rogers, 1983; Stephenson and Witte, 1998; Witte, 1992, 1994). The study results demonstrated that higher score of involvement lead to increased self efficacy. On the other hand, higher score on framing (due to negatively framed information) was associated with decreased self-efficacy. There was no effect of involvement and framing on response-efficacy. These results suggest that higher involvement may lead to increased scrutiny of the message recommendations and better understanding of the message resulting in increased self-efficacy. On the other hand, negative information leading to increased levels of worry may bring about defensive avoidance from the message and thus decreased self-efficacy (Van 't Riet, Ruiter, Werrij, and de Vries, 2010).

Post-hoc sample size determination was conducted to assess whether the study sample size was adequate to evaluate the effect on response-efficacy. The post-hoc sample size determination indicated that a sample size of 731 would be required to observe a significant effect of framing and 491 for a significant effect of involvement. The current therefore did not have an adequate sample size to observe these effects.

#### c) Effect on Intention

It was observed that involvement had a significant effect on intention to engage in preventive behaviors. Higher level of involvement was associated with greater intention to engage in preventive behaviors. Framing did not have a significant direct effect on intention.

Overall, it was observed that in the current study, positive framing was observed to be more impactful. However, the study results imply that the effectiveness of framing would depend on the underlying construct to be changed/modified i.e. the constructs which are salient to the population studied.

Negatively framed information had a positive impact on threat appeal variables (i.e. perceived vulnerability and severity). Hence, a population of older adults with low perception of disease severity may benefit from a negatively framed message as compared to a positively framed message. However, negatively framed information had a negative impact on coping appraisal (i.e. self-efficacy and response efficacy). Thus, in a population with pre-existing worries and low self-confidence, positively framed message may help in reinforcement and engagement in preventive behaviors.

### **Effect of Protection Motivation Theory Constructs on Intention**

The study results indicated that threat appeal (i.e. perceived severity and perceived vulnerability) and coping appeal (response-efficacy and self-efficacy) were positively and significantly associated with intention to engage in preventive behaviors. These results are consistent with prior PMT literature which states that higher perception of threat towards the undesirable event and higher perceptions of abilities of self as well as the behaviors in preventing the occurrence of the undesirable event, is associated with increased intention to engage in the recommended protective behaviors (Norman et al., 2005; Rogers, 1975).

The path analysis indicated that the proposed relationships in the original model had an unsatisfactory fit for the data. A revised model indicated that the constructs within PMT had mediating relationships, where perceptions of self (perceived vulnerability and self-efficacy) were mediators for the effect of involvement and message framing on perceived severity and response-efficacy.

### **Limitations**

The study results should be viewed in the light of certain limitations. Firstly, the study was conducted using an online platform (Qualtrics). As a result, the online nature of the study may have limited the outreach to population who are not active users of computers or technology or have no access. The use of online survey may have a few weaknesses compared with other data collection methods. While online, respondents may not be fully engaged in the survey or they may not complete the survey in one sitting, decreasing their

involvement with the survey. They may also terminate the survey early due to distraction, Internet connection issues, or browser issues.

Only English speaking older adults were recruited in the study. The results may therefore not be applicable for non-English speaking older adults.

Further it is well known that measuring behavior involves multi-dimensional concepts with many known and unknown variables that can affect the process or behavior under investigation. It is beyond the scope of any research to measure all the known variables that could affect a behavior. Further, there could be other unknown factors that had an effect on intention to engage in preventive behaviors which were not included in the study.

### **Implications Future study recommendations**

The study results can be regarded as a starting point for investigating the effects of involvement and framing on behaviors in the context of cognitive health or brain health.

Literature is abundant with studies evaluating the influence of framing and fear on other health behaviors such as physical exercise, use of sunscreen and screening behaviors.

However little is known about the influence of such factors in cognitive health behaviors.

Initiatives by NIH such as Healthy Brain Initiative have highlighted the need for development of effective messages to disseminate information about brain health.

Considering the high prevalence of fear associated with Alzheimer's and other brain diseases, the study offers insights into likely effects of fear (arising due to negatively framed information) on perceptions and behavioral intentions. Building onto findings from the current study, future studies evaluating the effect of framing and involvement on other behaviors in the context of cognitive health are warranted. Studies assessing

longitudinal effects of the study manipulations are also needed to understand if such factors have lasting effects on perceptions, intentions and behaviors. Findings from such studies can then be used in designing effective messages for communication of pertinent information for promoting brain health.

## **Conclusion**

The study demonstrated that a higher level of involvement was positively and significantly associated with increased threat appraisal and coping appraisal and intention to engage in preventive behaviors in the context of cognitive health maintenance.

Message framing was positively and significantly associated with increased threat appraisal but decreased coping appraisal, with an indirect influence on the intention to engage in preventive behaviors. These findings should be taken into consideration by health professionals attempting to develop communication materials to improve engagement in behaviors for brain health.

## APPENDIX A: INVOLVEMENT SCENARIOS

### LOW INVOLVEMENT

#### SCENARIO 1

Imagine that you are browsing through some online shopping websites and you see a pop-up ad.

Please take a moment to think about this situation.

## HIGH INVOLVEMENT

### SCENARIO 2

Imagine that a close friend of yours was recently diagnosed with early-onset Alzheimer's disease. This form of Alzheimer's is more likely to develop among those who have a family history of the disease. Since your friend's mother has had Alzheimer's for the past 5 years, your friend was at a high risk and now has started showing early symptoms of memory lapse and thinking problems.

This information concerns you. Just like your friend, you have a family history. Your father has Alzheimer's disease. He even tells you that your aunt had Alzheimer's before she passed away. You realize that you are at a high risk of developing the disease. Therefore you start looking for more information about the disease for yourself. As you are searching for information, you come across a print-ad.

Please take a moment to think about this situation.

## APPENDIX B: FRAMING VIGNETTES

### POSITIVE FRAMING

#### **Brain Health and Aging**

#### **A Step Towards Prevention for A Lifetime of Prosperity!**

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Imagine yourself living an ideal aging life in your 70s, 80s or beyond – healthy, happy and content. You are physically fit and independent, have no serious medical problems and have a sharp memory. You have rich social connections, active work life and a blissful family that you live with. All of it can be achieved if you keep your brain healthy and free from brain-diseases like Alzheimer's.

To reduce your risk for a brain-disease like Alzheimer's, train your brain for 20 minutes every day by using phone/computer-based brain-training programs and make them a part of your daily routine.

#### **Brain Health and Aging**

#### **A Step Towards Prevention for A Lifetime of Prosperity!**

---

Imagine yourself living an ideal aging life in your 70s, 80s or beyond – healthy, happy and content. You are physically fit and independent, have no serious medical problems and have a sharp memory. You have rich social connections, active work life and a blissful family that you live with. All of it can be achieved if you keep your brain healthy and free from brain-diseases like Alzheimer's.

To reduce your risk for a brain disease like Alzheimer's, learn a new complex skill such as speaking a foreign language, playing a musical instrument, build a piece of furniture, gardening or any other brain-challenging activity and practice it regularly for 2-3 hours per week.



## NEGATIVE FRAMING

### **Brain Health and Aging**

#### **Lack of Prevention Can Lead to A Dark and Lonely Future!**

---

Imagine being old and stranded in a dark forest all alone – you are lost, scared and frustrated. You have no memory of where you belong, who your loved ones are, and you’ve lost your identity. Your beautiful house, the places you’ve visited, and the life you’ve built with your family – it’s all gone. This is what a brain disease like Alzheimer’s does to you – it takes away everything from you.

To reduce your risk for a brain-disease like Alzheimer’s, train your brain for 20 minutes every day by using phone/computer-based brain-training programs and make them a part of your daily routine.

### **Brain Health and Aging**

#### **Lack of Prevention Can Lead to A Dark and Lonely Future!**

---

Imagine being old and stranded in a dark forest all alone – you are lost, scared and frustrated. You have no memory of where you belong, who your loved ones are, and you’ve lost your identity. Your beautiful house, the places you’ve visited, and the life you’ve built with your family – it’s all gone. This is what a brain disease like Alzheimer’s does to you – it takes away everything from you.

To reduce your risk for a brain disease like Alzheimer’s, learn a new complex skill such as speaking a foreign language, playing a musical instrument, build a piece of furniture, gardening or any other brain-challenging activity and practice it regularly for 2-3 hours per week.

## APPENDIX C: CODEBOOK

Variable	Question/Statement	Response options
<b>General health</b>	In general, would you say your health is:	1=Excellent 2=Very Good 3=Good 4=Fair 5=Poor
<b>Overall Health Status</b>	I frequently do things to improve my health	1=Strongly disagree 2=Disagree 3=Somewhat disagree 4=Neutral 5=Somewhat agree 6=Agree 7=Strongly agree
	I take vitamins/supplements regularly	
	I search for new information related to my health	
	I always take my flu vaccines	
<b>Health Literacy</b>	How confident are you filling out medical forms by yourself?	1=Not at all 2=A little bit 3=Somewhat 4=Quite a bit 5=Extremely
	How often do you need someone's help when you read instructions, pamphlets, or other written material from your doctor or pharmacy?	1=Never 2=Occasionally 3=Sometimes 4=Often 5=Always
<b>Involvement</b>		Low=0 High=1
<b>Framing</b>		Positive=1 Negative=1
<b>Perceived Severity</b>	The thought of Alzheimer's disease scares me.	1=Strongly disagree 2=Disagree 3=Somewhat disagree 4=Neutral 5=Somewhat agree 6=Agree 7=Strongly agree
	I would rather have other chronic diseases than have a brain disease like Alzheimer's.	
	Alzheimer's disease is probably the worst disease a person can get.	
<b>Perceived Vulnerability</b>	Compared to other people my age, I have a pretty good chance of getting Alzheimer's disease in the future.	1=Strongly disagree 2=Disagree 3=Somewhat disagree 4=Neutral 5=Somewhat agree 6=Agree 7=Strongly agree
	As I age, I am more likely to get Alzheimer's disease.	
	I feel the chances are good that I will get Alzheimer's disease in the future.	

<b>Self-efficacy</b>	I am confident that I can practice the suggested preventive measures regularly to reduce my risk for Alzheimer's disease.	1=Strongly disagree 2=Disagree 3=Somewhat disagree 4=Neutral 5=Somewhat agree 6=Agree 7=Strongly agree
	I am confident that I can find the appropriate resources that are needed to practice the suggested preventive measures to reduce my risk for Alzheimer's.	
	I am confident that I can make time in my every-day schedule to practice the suggested preventive measures regularly.	
	Practicing the suggested preventive measures regularly would help me feel more in control of my future.	
<b>Response-efficacy</b>	The suggested preventive measures will greatly reduce my risk of developing Alzheimer's disease in the future.	1=Strongly disagree 2=Disagree 3=Somewhat disagree 4=Neutral 5=Somewhat agree 6=Agree 7=Strongly agree
	The suggested preventive measures will greatly improve my quality of life.	
<b>Manipulation Checks</b>	After reading the scenario (and before viewing the actual ad), how motivated were you to read the information in the pop-up ad?	1=not at all 2=slightly 3=moderately 4=very 5=extremely
	I feel worried that I may get Alzheimer's as I grow old	
	The information in the ad made me feel troubled	
	The ad made me think about the positive aspects of healthy aging	
	The ad made me feel good about aging	
<b>Intention to take preventive measures immediately</b>	I intend to take the suggested preventive measures immediately.	1=Strongly disagree 2=Disagree 3=Somewhat disagree 4=Neutral 5=Somewhat agree 6=Agree 7=Strongly agree
<b>Future behaviors</b>	How likely is that you will request your doctor for an examination for an early diagnosis of Alzheimer's disease?	1=Extremely unlikely 2=Unlikely 3=Somewhat unlikely 4=Neutral 5=Somewhat likely 6=Likely 7=Extremely likely
	Currently there is no preventive medicine available which can protect you from brain diseases like Alzheimer's. In future, if such a medicine becomes available, how likely is it that you would take the medicine?	

<b>Education</b>	What is the highest grade (level of school) you have completed	1=None 2=1-4(elementary) 3=5-8 (Middle school) 4=9-12(high school) 5=13-16(college) 6=17-18(masters) 7= 19 or more (doctoral/PhD)
<b>Gender</b>		1=Male 2=Female
<b>Race/Ethnicity</b>	Please indicate your racial/ethnic background	1=Asian 2=Hispanic 3=White(non-Hispanic) 4=African-American 5=Native American 6=others
<b>Living situation</b>	Please indicate your living situation	1=living with partner/spouse 2=living with children/family 3=living alone 4=living at a care facility
<b>Insurance</b>	What is your insurance status?	1=private 2=government 0=no insurance
<b>Religious beliefs</b>	How often do you usually attend religious services such as church or temple?	1=never 2=once a year 3=a few times a year 4=at least once a month 5=at least once a week 6=nearly everyday
	How important is your spirituality or religious faith to you in making decisions about health?	1=Not at all important 2=somewhat important 3=important 4=very important 5=Extremely important
<b>Expectation regarding aging</b>	As people grow older, one thing or another will go wrong with their body	1=Strongly disagree 2=Disagree
	As people get older, they need to lower their expectations of how healthy they can be	3=Somewhat disagree

	There isn't any way to escape the wear and tear of aging	4=Neutral 5=Somewhat agree 6=Agree 7=Strongly agree
	The human body is like a car: when it gets old, it gets worn out	
	Part of the process of aging means, different parts of your body start breaking down	
<b>Past experiences</b>	Have you ever been tested/consulted for a brain disease like Alzheimer's?	0=No 1=Yes
	Before today, have you discussed about your risk for Alzheimer's with your doctor?	
<b>Family history</b>	Does anyone in your family/friends have Alzheimer's disease or any other brain disease?	
<b>Prior knowledge</b>	Have you read information about brain health or Alzheimer's earlier?	
	Before today, did you know about any preventive behaviors to reduce risk for Alzheimer's disease?	
<b>Past behavior</b>	Before today, did you practice any brain-stimulating activities on a regular basis?	
	Before today, have you used brain-training applications on a regular basis?	
	Do you have any health related apps on your phone?	
<b>Cognitive screening</b>	Problems with judgment (e.g., problems making decisions, bad financial decisions, problems with thinking)	0=No 1=Yes
	Less interest in hobbies/activities	
	Repeating the same things over and over	
	Trouble learning how to use a tool, appliance, or gadget	
	Forgetting correct month or year	
	Trouble handling complicated financial affairs	
	Trouble remembering appointments	
	Daily problems with thinking and/or memory	

## APPENDIX D: SURVEY

***Why am I being invited to take part in a research study?***

We invite you to take part in a research study because you are an adult residing in the United States.

***What should I know about a research study?***

Whether or not you take part is up to you. You can choose not to take part. You can agree to take part and later change your mind. Your decision will not be held against you.

***Why is this research being done?***

This study is being conducted to understand how individual characteristics and message characteristics affect the perceptions about a certain behavior. Understanding these factors will help in designing of effective public health messages in future.

***How long will the research last?***

We expect that you will be in this research study for 10-15 minutes. It is a one time survey which requires filling out a survey questionnaire.

***How many people will be studied?***

We expect to enroll about 350 people in this research study.

***What happens if I say yes, I want to be in this research?***

If you agree to participate in this study, you will be directed to an online survey questionnaire, which requires 10-15 minutes of your time to fill in.

***What happens if I do not want to be in this research?***

You can choose not to take part in the research. It will not be held against you and will involve no penalty or loss of benefit to which you are otherwise entitled.

***What happens if I say yes, but I change my mind later?***

You can leave the research at any time and it will not be held against you. In such case, recorded responses until that point of time will be considered.

***Is there any way being in this study could be bad for me?***

There are no foreseeable risks related to the procedures conducted as part of this study. If you choose to take part and undergo a negative event you feel is related to the study, please inform your study team.

***Will I get anything for being in this study?***

You will receive compensation as a token of appreciation for completing the survey. This compensation can be in the various forms such as game points, skymiles, actual cash, etc. If you elect to stop before the survey is completed, you will not be offered any compensation.

***Will being in this study help me in any way?***

There are no known direct benefits to you from your taking part in this research. However, researchers of this study expect to gain an understanding of how individual and message characteristics influence intention to undertake certain behaviors.

***What happens to the information collected for the research?***

No identifying information such as your name, address or email will be collected in this survey. Your responses will be completely anonymous.

---

***Who can I Talk to?***

If you have questions, concerns, or complaints, or think the research has hurt you, you should talk to the research team at Pharmaceutical Health Outcomes and Policy department, College of Pharmacy, The University of Houston or through email address [ssasngiry@uh.edu](mailto:ssasngiry@uh.edu) or through telephone no. – 832-842-8392.

This research has been reviewed and approved by the University of Houston Institutional Review Board (IRB). You may also talk to them at (713) 743-9204 or [cphs@central.uh.edu](mailto:cphs@central.uh.edu) if:

- Your questions, concerns, or complaints are not being answered by the research team.
- You cannot reach the research team.
- You want to talk to someone besides the research team.
- You have questions about your rights as a research subject.
- You want to get information or provide input about this research.

---

If you are willing to participate in this survey, please indicate your response by answering the question below and click on the 'Next' button. **I HAVE READ THE CONSENT INFORMATION AND AGREE TO TAKE PART IN THE STUDY.**

☐ I AGREE (1)

☐ I DISAGREE (2)

---

End of Block: Consent block

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Start of Block: Screening question (only 40-60 years)



What year were you born in?

---

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End of Block: Screening question (only 40-60 years)

---

Start of Block: General Health and Healthy Literacy

Section 1: Please answer the following questions to the best of your ability. There are no right or wrong answers.

Q1. In general, would you say your health is:

- ☐ Excellent 1 (1)
- ☐ Very Good 2 (2)
- ☐ Good 3 (3)
- ☐ Fair 4 (4)
- ☐ Poor 5 (5)

Q2. Based on your overall health status, please indicate your responses to the following statements:

	Strongly disagree	Disagree	Somewhat disagree	Neither agree nor disagree	Somewhat agree	Agree	Strongly agree
	1	2	3	4	5	6	7
I frequently do things to improve my health	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I take vitamins/supplements regularly	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I search for new information related to my health	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I always take my flu vaccines	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>



Q3. How confident are you filling out medical forms by yourself ?

- ☐ Not at all confident 1
  - ☐ A little bit confident 2
  - ☐ Somewhat confident 3
  - ☐ Quite a bit confident 4
  - ☐ Extremely confident 5
- 

Q4. How often do you need someone's help when you read instructions, pamphlets, or other written material from your doctor or pharmacy?

- ☐ Never 1
- ☐ Occasionally 2
- ☐ Sometimes 3
- ☐ Often 4
- ☐ Always 5

---

End of Block: General Health and Healthy Literacy

Start of Block: Survey flow description

**Next you will follow 3 steps,**

**Step 1:** You will be given a scenario. Please read the scenario very carefully. Imagine yourself to be in the situation described.

**Step 2:** Then, you will be asked to view an advertisement. Please view the information in the ad very carefully. Remember, it is very important that you read the advertisement while keeping in mind the scenario you read in Step 1.

**Step 3:** Then, you will answer a few questions based on the scenario and information in the advertisement you just read.

End of Block: Survey flow description

---

Start of Block: Involvement 1

#### SCENARIO 1

**Imagine that you are browsing through some online shopping websites and you see a pop-up ad.**

*Please take a moment to think about this situation.*

---

How motivated are you to read the information in the pop-up ad?

- ☐ Not at all Motivated 1
  - ☐ Slightly Motivated 2
  - ☐ Moderately Motivated 3
  - ☐ Very Motivated 4
  - ☐ Extremely Motivated 5
- 

When you are ready, click on the 'Next' button to view the pop-up ad.

End of Block: Involvement 1

---

Start of Block: Framing\_1

Please view the ad carefully. You have as much time as you need to view the ad.

---

### **Brain Health and Aging**

#### **Lack of Prevention Can Lead to A Dark and Lonely Future!**

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Imagine being old and stranded in a dark forest all alone – you are lost, scared and frustrated. You have no memory of where you belong, who your loved ones are, and you’ve lost your identity. Your beautiful house, the places you’ve visited, and the life you’ve built with your family – it’s all gone. This is what a brain disease like Alzheimer’s does to you – it takes away everything from you.

To reduce your risk for a brain-disease like Alzheimer’s, train your brain for 20 minutes every day by using phone/computer-based brain-training programs and make them a part of your daily routine.

Please view the ad carefully. You have as much time as you need to view the ad.

---

### **Brain Health and Aging**

#### **Lack of Prevention Can Lead to A Dark and Lonely Future!**

---

Imagine being old and stranded in a dark forest all alone – you are lost, scared and frustrated. You have no memory of where you belong, who your loved ones are, and you’ve lost your identity. Your beautiful house, the places you’ve visited, and the life you’ve built with your family – it’s all gone. This is what a brain disease like Alzheimer’s does to you – it takes away everything from you.

To reduce your risk for a brain disease like Alzheimer’s, learn a new complex skill such as speaking a foreign language, playing a musical instrument, build a piece of furniture, gardening or any other brain-challenging activity and practice it regularly for 2-3 hours per week.

Please view the ad carefully. You have as much time as you need to view the ad.

---

**Brain Health and Aging**  
**A Step Towards Prevention for A Lifetime of Prosperity!**

---

Imagine yourself living an ideal aging life in your 70s, 80s or beyond – healthy, happy and content. You are physically fit and independent, have no serious medical problems and have a sharp memory. You have rich social connections, active work life and a blissful family that you live with. All of it can be achieved if you keep your brain healthy and free from brain-diseases like Alzheimer's.

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Please view the ad carefully. You have as much time as you need to view the ad.

---

**Brain Health and Aging**  
**A Step Towards Prevention for A Lifetime of Prosperity!**

---

Imagine yourself living an ideal aging life in your 70s, 80s or beyond – healthy, happy and content. You are physically fit and independent, have no serious medical problems and have a sharp memory. You have rich social connections, active work life and a blissful family that you live with. All of it can be achieved if you keep your brain healthy and free from brain-diseases like Alzheimer's.

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Please click on the 'Next' button to proceed.

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End of Block: Framing\_1

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Start of Block: PMT\_1

Now, as you think about the on-line shopping scenario and the information you just read in the pop-up ad, please indicate your responses to the following questions. Please use the scale below to indicate your responses.

---



	SD 1	D 2	SWD 3	N 4	SWA 5	A 6	SA 7
The thought of a brain-disease like Alzheimer's disease scares me.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I would rather have other chronic diseases than have a brain disease like Alzheimer's	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
A brain-disease like Alzheimer's is probably the worst disease a person can get.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Compared to other people my age, I have a pretty good chance of getting a brain-disease like Alzheimer's in the future.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
As I age, I am more likely to get a brain-disease such as Alzheimer's.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I feel the chances are good that I will get Alzheimer's disease in the future.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I am confident that I can practice the suggested preventive measures regularly to reduce my risk for a brain-disease like Alzheimer's disease.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I am confident that I can find the appropriate resources that are needed to practice the suggested preventive measures.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I am confident that I can make time in my every-day schedule to practice the suggested preventive measures regularly	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

Practicing the suggested preventive measures regularly would help me feel more in control of my future.

☐☐☐☐☐☐☐

The suggested preventive measures will greatly reduce my risk of developing any brain-diseases like Alzheimer's in the future.

☐☐☐☐☐☐☐

The suggested preventive measures will greatly improve my quality of life.

☐☐☐☐☐☐☐

I intend to take the suggested preventive measures immediately.

☐☐☐☐☐☐☐

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Page Break

How likely is that you will request your doctor for an examination for an early diagnosis of a brain-disease like Alzheimer's?

- ☐ Extremely Unlikely (1)
  - ☐ Unlikely (2)
  - ☐ Somewhat unlikely (3)
  - ☐ Neutral (4)
  - ☐ Somewhat likely (5)
  - ☐ Likely (6)
  - ☐ Extremely Likely (7)
-

Currently there is no preventive medicine available which can protect you from brain diseases like Alzheimer's. In future, if such a medicine becomes available, how likely is it that you would take the medicine?

- ☐ Extremely unlikely (1)
- ☐ Unlikely (2)
- ☐ Somewhat unlikely (3)
- ☐ Neutral (4)
- ☐ Somewhat likely (5)
- ☐ Likely (6)
- ☐ Extremely likely (7)

End of Block: PMT\_1

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Start of Block: Manipulation check\_1

What were the thoughts that you had while you were reading the information in the pop-up ad? (Describe your thoughts in the box below).

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Indicate the feelings that you experienced while reading the information in the pop-up ad?

	Not at all 1	Slightly 2	Moderately 3	Very 4	Extremely 5
The ad made me feel worried about the bad things that can happen due to a brain-disease like Alzheimer's	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
The ad made me feel disturbed and troubled	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
The ad made me feel happy about my brain-health	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
The ad gave me a feeling of comfort and hope	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

End of Block: Manipulation check\_1

Start of Block: Demographics

Q1. Before you move to the next section, please answer the following questions:

\*\*\*\*\*

Q2. What is the highest grade (level of school) you have completed?

- ☐ 0 (None)
  - ☐ 1 - 4 (Elementary school)
  - ☐ 5 - 8 (Middle school)
  - ☐ 9 - 12 (High school)
  - ☐ 13 - 16 (College)
  - ☐ 17 - 18 (Masters)
  - ☐ >19 (Doctoral/PhD)
- 

Q3. Gender

- ☐ Male
  - ☐ Female
- 

Q4. Please indicate your racial/ethnic background

- ☐ Asian
  - ☐ Hispanic
  - ☐ White (non-Hispanic)
  - ☐ African-American
  - ☐ Native American
  - ☐ Others (Please Specify) \_\_\_\_\_
-

Q5. Please indicate your living situation:

- ☐ Living with Partner/Spouse
  - ☐ Living with Children/Family
  - ☐ Living alone
  - ☐ Living at a care facility
- 

Q6. What is your insurance status?

- ☐ Private insurance
  - ☐ Government (Medicare/Medicaid)
  - ☐ No Insurance
- 

Q7. How often do you usually attend religious services such as church or temple?

- ☐ Never 1
  - ☐ Once a year 2
  - ☐ A few times a year 3
  - ☐ At least once a month 4
  - ☐ At least once a week 5
  - ☐ Nearly everyday 6
-

Q8. How important is your spirituality or religious faith to you in making decisions about health?

- ☐ Not at all Important 1
- ☐ Somewhat Important 2
- ☐ Important 3
- ☐ Very Important 4
- ☐ Extremely Important 5

End of Block: Demographics

---

Start of Block: Transition block

Please take a few moments to relax before you proceed to the next section. Watch the video below. Once done, you will be automatically directed to the next page.

Click on the video to begin. [Note: The video is embedded in the survey. Participants will only have to click on the video for it to begin. The video will be played for approximately 40 seconds. The video is set to automatically stop at 40 seconds and proceed to the next page.]

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<https://www.youtube.com/watch?v=LjCzPp-MK48>

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Page Break

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When you are ready, click on the 'Next' button to proceed.

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Page Break

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Section 3: This is the last section. You will follow the same steps as before. However, the information presented in this section is new and different from the previous set.

---

End of Block: Transition block

---

Start of Block: Involvement 2

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Imagine yourself in the following situation.

---

## SCENARIO 2

Imagine that a close friend of yours was recently diagnosed with early-onset Alzheimer's disease. This form of Alzheimer's is more likely to develop among those who have a family history of the disease. Since your friend's mother has had Alzheimer's for the past 5 years, your friend was at a high risk and now has started showing early symptoms of memory lapse and thinking problems.

This information concerns you. Just like your friend, you have a family history. Your father has Alzheimer's disease. He even tells you that your aunt had Alzheimer's before she passed away. You realize that you are at a high risk of developing the disease. Therefore you start looking for more information about the disease for yourself. As you are searching for information, you come across a print-ad.

Please take a moment to think about this situation.

---



How motivated are you to read the information in the print-ad?

- ☐ Not at all Motivated 1
- ☐ Slightly Motivated 2
- ☐ Moderately Motivated 3
- ☐ Very Motivated 4
- ☐ Extremely Motivated 5

---

When you are ready, click on the 'Next' button to view the print-ad.

End of Block: Involvement 2

---

Start of Block: Framing 2

Please view the ad carefully. You have as much time as you need to view the ad.

---

### **Brain Health and Aging**

#### **Lack of Prevention Can Lead to A Dark and Lonely Future!**

---

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To reduce your risk for a brain-disease like Alzheimer’s, train your brain for 20 minutes every day by using phone/computer-based brain-training programs and make them a part of your daily routine.

---

Please view the ad carefully. You have as much time as you need to view the ad.

---

**Brain Health and Aging**  
**Lack of Prevention Can Lead to A Dark and Lonely Future!**

---

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Please view the ad carefully. You have as much time as you need to view the ad.

---

### **Brain Health and Aging**

#### **A Step Towards Prevention for A Lifetime of Prosperity!**

---

Imagine yourself living an ideal aging life in your 70s, 80s or beyond – healthy, happy and content. You are physically fit and independent, have no serious medical problems and have a sharp memory. You have rich social connections, active work life and a blissful family that you live with. All of it can be achieved if you keep your brain healthy and free from brain-diseases like Alzheimer's.

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Please view the ad carefully. You have as much time as you need to view the ad.

---

**Brain Health and Aging**  
**A Step Towards Prevention for A Lifetime of Prosperity!**

---

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To reduce your risk for a brain disease like Alzheimer's, learn a new complex skill such as speaking a foreign language, playing a musical instrument, build a piece of furniture, gardening or any other brain-challenging activity and practice it regularly for 2-3 hours per week.

---

Please click on the 'Next' button to proceed.

---

End of Block: Framing 2

---

Start of Block: PMT\_2

---

Now, as you think about the scenario (your father has Alzheimer's and you have a high-risk) and the information you just read in the print-ad, please indicate your responses to the following questions. Please use the scale below to indicate your responses.

---

	SD 1	D 2	SWD 3	N 4	SWA 5	A 6	SA 7
The thought of a brain-disease like Alzheimer's disease scares me.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I would rather have other chronic diseases than have a brain disease like Alzheimer's.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
A brain-disease like Alzheimer's is probably the worst disease a person can get.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Compared to other people my age, I have a pretty good chance of getting a brain-disease like Alzheimer's in the future.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
As I age, I am more likely to get a brain-disease such as Alzheimer's.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I feel the chances are good that I will get Alzheimer's disease in the future.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I am confident that I can practice the suggested preventive measures regularly to reduce my risk for a brain-disease like Alzheimer's disease.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I am confident that I can find the appropriate resources that are needed to practice the suggested preventive measures.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I am confident that I can make time in my every-day schedule to practice the suggested preventive measures regularly.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

Practicing the suggested preventive measures regularly would help me feel more in control of my future.

☐☐☐☐☐☐☐

The suggested preventive measures will greatly reduce my risk of developing any brain-diseases like Alzheimer's in the future.

☐☐☐☐☐☐☐

The suggested preventive measures will greatly improve my quality of life.

☐☐☐☐☐☐☐

I intend to take the suggested preventive measures immediately.

☐☐☐☐☐☐☐

---

Page Break

How likely is that you will request your doctor for an examination for an early diagnosis of Alzheimer's disease?

- ☐ Extremely Unlikely (1)
  - ☐ Unlikely (2)
  - ☐ Somewhat unlikely (3)
  - ☐ Neutral (4)
  - ☐ Somewhat likely (5)
  - ☐ Likely (6)
  - ☐ Extremely Likely (7)
- 

Currently there is no preventive medicine available which can protect you from brain diseases like Alzheimer's. In future, if such a medicine becomes available, how likely is it that you would take the medicine?

- ☐ Extremely unlikely (1)
- ☐ Unlikely (2)
- ☐ Somewhat unlikely (3)
- ☐ Neutral (4)
- ☐ Somewhat likely (5)
- ☐ Likely (6)
- ☐ Extremely likely (7)

---

End of Block: PMT\_2

Start of Block: Manipulation check\_2

What were the thoughts that you had while you were reading the print-ad? (Describe your thoughts in the box below).

---



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---



---

Indicate the feelings that you experienced while reading the information in the pop-up ad?

	Not at all	Slightly	Moderately	Very	Extremely
	1	2	3	4	5
The ad made me feel worried about the bad things that can happen due to a brain-disease like Alzheimer's	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
The ad made me feel disturbed and troubled	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
The ad made me feel happy about my brain-health	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
The ad gave me a feeling of comfort and hope	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

End of Block: Manipulation check\_2

Start of Block: ERA



Finally, we would like to ask you a few general questions. Please indicate your responses to the best of your ability. There are no right or wrong answers.

Please indicate your responses to the following statements based on how you feel about aging in general:

	Strongly disagree	Disagree	Somewhat disagree	Neither agree nor disagree	Somewhat agree	Agree	Strongly agree
	1	2	3	4	5	6	7
As people grow older, one thing or another will go wrong with their body	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
As people get older, they need to lower their expectations of how healthy they can be	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
There isn't any way to escape the wear and tear of aging	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
The human body is like a car: when it gets old, it gets worn out	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Part of the process of aging means, different parts of your body start breaking down	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

End of Block: ERA

Start of Block: Brain health behaviors

Please mark YES or NO for the following questions based on your own experience:

	YES	NO
Have you ever been tested/consulted for a brain disease like Alzheimer's?	<input type="radio"/>	<input type="radio"/>
Have you read information about brain health or Alzheimer's earlier?	<input type="radio"/>	<input type="radio"/>
Does anyone in your family/friends have Alzheimer's disease or any other brain disease? If yes, who? (Please type all in the white box)	<input type="radio"/>	<input type="radio"/>
Before today, have you discussed about your risk for Alzheimer's with your doctor?	<input type="radio"/>	<input type="radio"/>
Before today, have you used brain-training applications on a regular basis?	<input type="radio"/>	<input type="radio"/>
Before today, did you practice any brain-stimulating activities on a regular basis?	<input type="radio"/>	<input type="radio"/>
Before today, did you know about any preventive behaviors to reduce risk for Alzheimer's disease? Is yes, which ones? (Please type in the white box)	<input type="radio"/>	<input type="radio"/>
Do you have any health related apps on your phone?	<input type="radio"/>	<input type="radio"/>

End of Block: Brain health behaviors

Start of Block: Cognitive Health Screening

Please indicate whether there has been a change in the specified functions provided below in the last several years caused specifically by cognitive problems (thinking and memory).

Remember, "YES, a change" indicates that there has been a change in the last several years caused by cognitive (thinking and memory) problems.

	YES, A change	NO, No change	N/A, Don't Know
1. Problems with judgment (e.g., problems making decisions, bad financial decisions, problems with thinking)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
2. Less interest in hobbies/activities	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
3. Repeating the same things over and over (questions, stories, or statements)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
4. Trouble learning how to use a tool, appliance, or gadget (e.g., VCR, computer, microwave, remote control)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
5. Forgetting correct month or year	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
6. Trouble handling complicated financial affairs (e.g., balancing checkbook, income taxes, paying bills)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
7. Trouble remembering appointments	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
8. Daily problems with thinking and/or memory	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

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