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Mindset of Aging and Implicit Attitudes, Self-belief Outcomes, and Working Memory in Rural,
Community-Dwelling Older Adults

by

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Committee Approval

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Mindset of Aging and Implicit Attitudes, Self-belief Outcomes, and Working Memory in Rural,
Community Dwelling Older Adults

Thesis Abstract—Idaho State University (2019)

Growth mindset of aging (MA) refers to the belief that the aging process is malleable, while fixed MA refers to the belief that the aging process is non-malleable. Using experimental methods, this thesis aimed to explore the novel impact that MA has on implicit old-age attitudes, self-perceptions of aging (SPA), age identity, and working memory. 86 older participants ($M_{\text{age}} = 66.72$ years) were randomly placed into either a growth or fixed MA condition and tested on the outcomes of interest. Analyses revealed that although the two groups significantly differed on MA scores following the manipulation, MA did not significantly influence any of the outcomes of interest. However, having more of a growth MA was related to less negative implicit old-age attitudes and more positive SPA. These results demonstrate that having more of a growth MA relates to beneficial psychological outcomes, and should be promoted in older populations.

Keywords: mindset of aging, implicit attitudes, self-perceptions of aging, age identity, working memory, older adults

Chapter 1: Mindset of Aging, Implicit and Explicit Old-Age Attitudes, and Working Memory

The developmental process of aging can hold a variety of different meanings for different people. For example, some may believe aging to be a process of decline and loss while others may perceive it as a time of growth and learning. How one thinks about the malleability of their aging process, as well as that of others, may be referred to as one's mindset of aging (MA) (Weiss & Grah, 2014). Moreover, sentiments about the aging process and attitudes towards older adults can be both explicit (i.e., lucid) or implicit, meaning out of conscious awareness. Implicit attitudes individuals hold towards older adults have been investigated previously, (e.g., Tam, Hewstone, Harwood, Voci, & Kenworthy, 2006), yet not in terms of older adults' MA. This is of interest because implicit attitudes have been shown to relate to important social behaviors such as friendliness in verbal and non-verbal exchanges (Dovidio, Kawakami, & Gaertner, 2002). Furthermore, explicit measures yet to be explored as an outcome of MA are self-perceptions of aging and age identity. Additionally, previous researchers have only examined the relationship between MA and cognition minimally (Weiss, 2016). To further this line of research, the present study sought to investigate the influence of MA on implicit old-age attitudes, self-perceptions of aging, age identity, and working memory in a sample of rural, community-dwelling older adults in Idaho.

Mindset

There exists a spectrum of beliefs about the flexibility of personal characteristics, most often referred to as mindset (Chiu, Hong, & Dweck, 1997). This mindset spectrum encompasses an individual's essential assumptions about themselves and the world around them (Molden & Dweck, 2006). An individual may fall anywhere on this mindset spectrum, but researchers often

examine the two most extreme ends, which are referred to as growth or fixed mindset. Holding a belief that personal aspects or qualities are malleable is endorsing more of a growth mindset, while a fixed mindset entails the belief that these things are non-malleable (Dweck, Hong, & Chiu, 1993). For example, with personality traits, those holding more of a growth mindset would believe that personalities are changeable as opposed to someone holding a fixed mindset, who would assume that personality traits are stable and inherent to an individual (Dweck, Chiu, & Hong, 1995). Importantly, holding a predominantly growth or fixed mindset influences various aspects of life within the psychological and social domains. For example, having more of a growth mindset of relationships is associated with more adaptive problem resolution in romantic relationships (Howell, 2016).

Another area of mindset that has garnered a great deal of attention is that of intelligence, especially in children and college-aged individuals. In a study of middle school-aged children, students who underwent an intervention promoting a growth mindset of intelligence displayed an upward trajectory in grades as well as a positive change in classroom motivation overall, providing support for the capability of changing one's mindset of intelligence and the important implications these changes can have (Blackwell, Trzesniewski, & Dweck, 2007). Additionally, this type of mindset has been shown to influence stereotype threat, which refers to members of a negatively stereotyped group being at risk for conforming to that stereotype (Steele & Aronson, 1995). In one study, African American college students taught a growth mindset of intelligence reported greater academic engagement and higher grades than the control group, displaying resistance to stereotype threat in the process (Aronson, Fried, & Good, 2002). This finding provides support that having more of a growth mindset can be protective against negative outcomes associated with stereotypes.

However, whether having more of a growth mindset of *aging* positively influences psychological outcomes requires further examination.

Mindset of Aging

While it is certain that people will age, mindset of aging (MA) specifies how much one believes the aging process is malleable and whether or not this process is able to be influenced by lifestyle behaviors (Weiss, 2016). The MA literature is presently quite limited, though there has been some research examining the relationship between MA and health. For example, one study sought to investigate the relationship between MA and stress in adults over the age of 60 years. In this study, following a cognitively challenging task, those with more of a fixed MA displayed elevated cortisol reactivity, which relates to stress and memory impairment (Lupien et al., 1997), compared to those holding more of a growth MA indicating that MA is associated with physiological health outcomes (Weiss & Weiss, 2016). Just as other forms of growth mindset (e.g., of intelligence) can successfully be shaped, MA has also been investigated using an experimental design. To the author's knowledge, there is only one published report that examines MA using experimental procedures. In this experiment, older participants were randomly assigned to either a growth or fixed MA condition by reading false newspaper articles that described aging in terms of either a growth or fixed mindset. Results showed that the participants in the fixed MA condition reported a more restricted future time perspective and endorsed higher scores of perceived threat when thinking about their aging compared to participants in the growth MA group (Weiss, Job, Mathias, Grah, & Freund, 2016). This is an important finding that provides support for researching additional psychological outcomes which may be influenced by MA, for example, implicit attitudes.

Implicit Attitudes

While mindset refers to beliefs about the inherent malleability of personal characteristics, implicit attitudes are implicitly held associations or stereotypes about a specific group, with the term implicit meaning out of conscious awareness or control (Greenwald & Krieger, 2006). For example, although an employer may overtly state that they have no age preference for employees, their actions may display negative implicit old-age attitudes such as selecting younger over older job applicants. To illustrate, one study found that when given resumes with names and hobbies that appeared to belong to older applicants, employers deemed them less suitable for a job opening than applicants with resumes with names and hobbies that appeared to belong to younger applicants with the same qualifications (Derous & Decoster, 2017). While this example of implicit old-age attitudes may seem like ageism (i.e., prejudice against the old) it cannot technically be considered as such. For an action to be considered prejudice, it must be a conscious, negative evaluation of members of a social group based on group membership. Implicit attitudes are out of conscious rule (Abrams, 2010) and importantly, while they can be positive at times, implicit old-age attitudes are predominantly found to be negative (Perdue & Gurtman, 1990). This has clear consequences, especially for older adults in the job market, but the implications of implicit old-age attitudes are farther reaching. For example, data collected from a large-scale study of individuals aged from 8 to 70+ years found that of all the implicit attitudes measured (i.e., age, race, sex, science and liberal arts stereotypes), negative implicit old-age attitudes were the strongest (Nosek, Banaji, & Greenwald, 2002). Older adults themselves have been found to hold negative implicit old-age attitudes against those in their same age brackets, with one study finding that participants 75 years and older displayed greater negative implicit attitudes for older compared

to younger participants (Hummert, Garstka, O'Brien, Greenwald, & Mellott, 2002). More recently, in a study of participants 18-94 years old, it was found that of any age group, negative implicit old-age attitudes were highest amongst older adults themselves (Chopik & Giasson, 2017). Furthermore, although these implicit old-age attitudes are outside of conscious awareness, discriminatory behaviors towards older adults can still occur as a result, such as avoidance (Chen & Bargh, 1999), unfriendly behaviors (Dovidio et al., 2002), refusal to hire (Derous & Decoster, 2017) or refusal to rent property to older adults (Levy, 2001). Taken together, these studies demonstrate the critical importance of pursuing a mechanism for changing implicit old-age attitudes in older adults from negative to positive.

The idea that implicit attitudes occur out of conscious awareness is particularly of interest, as these attitudes may be contrary to what an individual explicitly endorses, especially when the topic is socially sensitive, motivating the respondent to answer with less prejudice (Hofmann, Gschwendner, Castelli, & Schmitt, 2008). When it comes to explicit versus implicit old-age attitudes, results are similar. For example, when explicitly asked about the capacity for sexual interest extending into late life, young adults overtly responded positively but implicitly were against sexual behaviors in old age (Thompson, O'Sullivan, Byers, & Shaughnessy, 2014). Older adults also show inconsistency among their explicit and implicit old-age attitudes. For example, although older adults were not found to explicitly endorse the stereotype that old people are bad drivers, their implicit attitudes showed the opposite (Lambert, Seegmiller, Stefanucci, & Watson, 2013). Therefore, when examining the possible influences of mindset of aging (MA), it is critical to examine implicit measures in conjunction with explicit measures, as doing so can reveal a greater scope of attitudes.

Importantly, implicit attitudes are responsive to manipulation (Devine, Forscher, Austin, & Cox, 2012). For example, individuals who were asked to imagine talking to an older adult displayed less negative implicit old-age attitudes compared to those who were just asked to think about an older adult (Turner & Crisp, 2010). However, to the author's knowledge, only one study has examined mindset and implicit attitudes, specifically the relationship between mindset of prejudice and implicit race attitudes (Carr, Dweck, & Pauker, 2012). Thus, the extent to which mindset of *aging* relates to implicit *old-age* attitudes, and furthermore, whether experimental priming of either a growth or fixed MA can impact implicit old-age attitudes in older adults has not yet been investigated. One aim of the current experiment is to explore such an impact. Furthermore, examining implicit old-age attitudes is important because implicit and explicit attitudes are not always reflective of one another (Levy & Banaji, 2002). For this reason, the influence of MA was additionally examined in explicit attitudes, specifically in the form of self-perceptions of aging.

Self-Perceptions of Aging

As mentioned, perceptions of older adults and aging are typically found to be negative, with old age often associated with severe impairment, vulnerability, reclusiveness, and incompetence (Hummert, 1990; Hummert, Garstka, Shaner, & Strahm, 1994). As individuals age, these perceptions of older adults can be focused inward toward the self. This introspective view of aging has become known as self-perceptions of aging (Levy, 2003). Self-perceptions of aging (SPA) differ from mindset of aging (MA) in that SPA refers to how individuals view themselves becoming older, along with any expectations or beliefs this may include. For example, someone with negative SPA would likely endorse the idea that as they get older, the quality of their life will diminish. Thus, while MA refers to beliefs about the malleability of how one will age, SPA refers

to how positively or negatively one views their own aging process (Levy, 2003; Robertson, King-Kallimanis, & Kenny, 2016).

Positive SPA are associated with better subjective health ratings in cross-sectional research (Moor, Zimprich, Schmitt, & Kliegel, 2006). In addition, older adults who report more positive SPA walk greater distances, engage in more daily activities (Beyer, Wolff, Warner, Schüz, & Wurm, 2015), are less likely to die from respiratory causes (Levy & Myers, 2005), display greater levels of physical activity (Palacios, Torres, & Mena, 2009), and have a faster walking speed (Robertson, Savva, King-Kallimanis, & Kenny, 2015). Additionally, longitudinal findings suggest a link between positive SPA and physical outcomes years later, such that those with more positive SPA at baseline demonstrate better functional health over 18 years (Levy, Slade, & Kasl, 2002a) and, in a separate study, indicate better self-rated health two years later, as well as live on average 7.5 years longer than those who report more negative SPA (Levy, Slade, Kunkel, & Kasl, 2002b). Furthermore, positive SPA correlates with higher life satisfaction (Kiarsipour, Borhani, Esmaeili, & Zayeri, 2017). SPA have also been shown to relate to cognition in older adults. For example, longitudinally, negative SPA have been associated with declines in verbal fluency and self-rated memory (Robertson & Kenny, 2016), while cross-sectionally, positive SPA relate to better memory performance in free recall tasks (Levy & Langer, 1994). Other factors associated with negative SPA include low economic status, lower education, living in solitude, multiple chronic medical conditions, depressive feelings, poor vision, and high levels of neuroticism (Jang, Poon, Kim, & Shin, 2004; Moser, Spagnoli, & Santos-Eggimann, 2011). In sum, while negative SPA are associated with poorer health and wellness outcomes, SPA that are positive are linked to beneficial outcomes. Thus, it is critical to examine mechanisms that can alter SPA from negative to positive, as doing so may allow for the benefits of positive SPA, such as higher life satisfaction and

increased longevity, to be experienced by older adults. Taken together, research has shown that SPA can have an influence on multiple important aspects of life, and having a positive SPA can serve as a means of successfully sustaining one's physical and psychological health over time. Perceiving aging as a time of positive change could feasibly be influenced by a growth mindset. Thus, one goal of the current study was to test the influence that primed MA would have on SPA, as well as the additional explicit measure of age identity.

Age Identity

Chronological age refers to the number of years one has been alive, while age identity refers to the age that one feels (Montepare & Lachman, 1989). Age identity is distinct from mindset of aging (MA) because while the latter refers to the malleability of the aging process, age identity is how old one feels outside of how malleable, fixed, positive, or negative the aging process is viewed to be. For example, an individual could have a chronological age of 75 years but an age identity of 60 years. Indeed, older individuals tend to feel younger and therefore have a younger age identity than their chronological age (Kaufman & Elder Jr, 2002), and this finding is observed in relation to both health and well-being. For example, those with a younger age identity are more likely to have better physical and psychological health, and are less likely to have experienced a decline in physical functioning (Bowling, See-Tai, Ebrahim, Gabriel, & Solanki, 2005). Having a more youthful age identity is also associated with greater reports of subjective well-being, greater life satisfaction, and positive affect even after controlling for sociodemographic variables such as chronological age, gender, socioeconomic status, health, and marital and employment status (Westerhof & Barrett, 2005). Taken together, feeling younger than one's chronological age has a multitude of health and well-being correlates.

On the other hand, older age identities are associated with worse health, less favorable predictions of future health, lower socioeconomic status (Barrett, 2003), and declining health in older adults (Uotinen, Rantanen, & Suutama, 2005). Furthermore, SPA are linked to age identity. A longitudinal study found that individuals whose SPA became more negative over time also displayed increasingly older age identities, compared to those who endorsed more positive SPA over time (Kotter-Grühn, Kleinspehn-Ammerlahn, Gerstorf, & Smith, 2009). This finding additionally corresponded with an increased risk of death over the following 12 years. Therefore, maintaining a younger age identity is important for one's health and longevity.

Age identity is conjointly observable in the social domain, and has been explained in some measure using social comparison. For example, having a favorable self-evaluation in comparison to same-age peers is correlated with younger age identity (Bultena & Powers, 1978). Additionally, social comparison can be induced. Older adults who were informed that their grip strength after initial testing was 80% higher than that of same-aged peers reported a younger age identity as well as a *physical* increase in grip strength during a follow-up test minutes later compared to those in the control group (Stephan, Chalabaev, Kotter-Grühn, & Jaconelli, 2012). These results demonstrate that not only can physical grip strength be altered, but age identity can be altered as well. The relevance and malleability of age identity have been investigated with regard to social comparison, though lacking in the literature is the influence of MA on age identity. Specifically, how one perceives aging as malleable or non-malleable has not previously been investigated in relation to the subjective age that one feels. The current study aimed to fill this gap by additionally exploring the relationship between MA and age identity.

Working Memory

Lastly, this experiment examined the impact of mindset of aging (MA) on working memory performance. Prior research has shown that while having a more positive outlook on aging is associated with better recall memory (Levy & Langer, 1994), improvements in memory performance can also be induced using positive perceptions. For example, in comparison to a control condition, priming older adults with positive aging stereotypes (i.e., using a scrambled sentence task containing positive words related to aging) has been shown to result in better free recall memory (Hess, Hinson, & Statham, 2004). In a similar study, older adults were primed with aging stereotypes by briefly being shown either positive (e.g., insightful) or negative (e.g., senile) words on a computer screen just below conscious awareness. Those primed with a negative aging stereotype displayed lower performance on immediate, learned, delayed, and auditory recall tasks, however, those primed with a positive aging stereotype displayed higher performance on immediate, learned, and delayed recall (Levy, 1996). Importantly, these studies demonstrate that different types of memory are susceptible to improvement in older adults, at least in the short term. In terms of MA, prior research has shown that subjects who endorsed more of a fixed MA displayed poorer immediate recall memory than those who endorsed more of a growth MA (Weiss, 2016). What has yet to be examined, which the present thesis aimed to do, is the impact of MA on the higher-order cognitive skill of working memory.

Working memory is the retention and manipulation of information learned within a short amount of time (Ricks, Turley-Ames, & Wiley, 2006). For example, when taking a multiple-choice test, individuals are required to hold a question in mind while reviewing the list of possible corresponding answers. Working memory has been assessed in older adults over the last few decades with robust findings indicating that performance in older adulthood is lower compared to

young adulthood (Babcock & Salthouse, 1990; Dobbs & Rule, 1989; Reuter-Lorenz et al., 2000; Wingfield, Stine, Lahar, & Aberdeen, 1988) and declines with age (Chen, Hale, & Myerson, 2003; McCarrey, An, Kitner-Triolo, Ferrucci, & Resnick, 2016; Myerson, Emery, White, & Hale, 2003). Potential causes include a reduction in processing speed with age (Salthouse & Babcock, 1991) that subserves working memory, as well as declining inhibitory functions, making working memory weaker with increasing age (Hasher, Zacks, & May, 1999; May, Hasher, & Kane, 1999; Salthouse & Babcock, 1991). However, previous research has shown that working memory in older adults can be improved. In one study, 80-year-old adults who received working memory training twice per week for three months displayed marked improvements in working memory tasks compared to the active control group (Buschkuhl et al., 2008). In another study, 80 adults aged 65-95 years engaged in nine training sessions lasting three weeks to enhance either visuospatial working memory, verbal working memory, or executive control. Following training, older adults trained in all areas of working memory displayed greater performance compared to a control group, with training effects still evident nine months later (Zinke et al., 2014). These results are encouraging. However, training procedures are not the only way to improve working memory, as priming also shows the ability to enhance performance.

Priming older participants with either a growth or fixed mindset of *memory ability* has been shown to influence both free recall and working memory performances. One study asked participants to read fabricated articles describing memory in terms of either growth or fixed mindset, followed by a free recall task and a reading span task. Those given the growth mindset of memory article performed better on both the free recall and reading span tasks compared to participants who read the fixed mindset of memory article (Plaks & Chasteen, 2013). Together, these findings suggest that working memory can be influenced by factors other than age, such as

training or having a growth mindset of memory. However, missing from the literature is whether priming a growth mindset of *aging* affects this cognitive skill. Determining whether working memory can be improved by changing one's MA is of paramount importance because working memory is necessary for everyday functioning such as reasoning, comprehension, and long-term learning (Baddeley, Logie, Bressi, Sala, & Spinnler, 1986). The present study aimed to achieve this goal by priming MA in older adults and subsequently testing working memory performance.

Present Study

Mindset has been shown to have an impact on multiple aspects of life, such as intelligence and personality (Molden & Dweck, 2006), though in relation to aging the research is minimal. To date, the only research on mindset of aging (MA) has been with future time perspective and perceived age-related threat (Weiss et al., 2016), cortisol reactivity in older adults following a cognitively challenging task (Weiss & Weiss, 2016), and as a moderator of the impact of negative stereotypes on free-recall memory performance (Weiss, 2016). It is mindset of *memory*, not MA, which previous research relates to free recall scores and working memory (Plaks & Chasteen, 2013). Thus, there is a clear research gap which this thesis aimed to address. Specifically, the present study analyzed the influence of MA on implicit old-age attitudes, self-perceptions of aging (SPA), age identity, and working memory in older adults.

To capture in more detail the influence MA has on psychological aging, additional facets outside of explicit beliefs need to be recognized, such as implicit old-age attitudes. To the author's knowledge, no research on the relationship between MA and implicit old-age attitudes has occurred. Moreover, explicit and implicit measures of attitudes often do not correlate when the subject matter is sensitive, such as when older adults are being assessed on their attitudes of other older adults (Lambert et al., 2013). Thus, investigating the impact that priming a growth or fixed

mindset of aging has on implicit old-age attitudes is important. Implicit association tests allow for unconscious attitudes to be illuminated, allowing for a richer understanding of psychological aging than explicit measures alone.

The most widely utilized method for assessing implicit attitudes is the Implicit Association Test (IAT). The IAT measures automatic evaluations of stimuli, such as old or young faces, providing insight into unconscious old-age attitudes (Greenwald, McGhee, & Schwartz, 1998). A number of explicit measures of SPA exist, but the Image of Aging scale is unique in that it assesses the images that come to mind when asked to think about aging (Levy, Kasl, & Gill, 2004) as opposed to expectations or stereotypes of aging (Kavirajan et al., 2011). To capture age identity, most of the previous research utilizes a difference score between older adult's chronological age and perceived or subjective age so that adults of differing chronological ages may be easily compared (Kotter-Grühn, Kornadt, & Stephan, 2016). Lastly, previous research has demonstrated the influence that mindset of *memory* can have on free recall tasks and working memory in reading span tasks (Plaks & Chasteen, 2013). However, MA and working memory, as tested using the Operation Span Task (OSPAN) in the present experiment, remains under-investigated. While both reading span tasks and the OSPAN jointly tap the storage and processing aspects of working memory, the OSPAN utilizes mathematical equations as distractors rather than reading sentences for comprehension, allowing for a decrease in the interference from words in sentences of to-be-remembered words (Conway et al., 2005). Therefore, assessing the effect of MA on working memory using the OSPAN is not only novel, but the OSPAN is arguably a more valid measure of working memory performance. Taken together, this study used a methodology that included both implicit and explicit outcomes that provided a comprehensive assessment of MA's influence on various aspects of psychological aging.

A further novel aspect of the current study is the population under examination. Psychological aging research often occurs within urban settings, and there is less known about this developmental process in rural-dwelling individuals (Baernholdt, Yan, Hinton, Rose, & Mattos, 2012; Skoufalos, Clarke, Ellis, Shepard, & Rula, 2017). The structure and culture of rural environments may have a discernible impact on the psychological outcomes in question. Access to health resources, community support, and government bodies are just a few of the influences that differ between rural and urban older populations (Dibartolo & McCrone, 2003). Thus, it is critically important to examine these psychological outcomes within rural settings. Although the scope of this study did not include a geographical comparison across populations, the findings from this study can be of use as a preliminary indicator of MA manipulations in rural-dwelling older individuals.

Hypothesis: Individuals primed with a growth mindset of aging will exhibit more positive implicit old-age attitudes, more positive self-perceptions of aging, a younger age identity, and greater performance on a task of working memory than individuals primed with a fixed mindset of aging.

Chapter 2: Method

Participants

The required sample size was determined using G-Power statistical software (Erdfelder, Faul, & Buchner, 1996). Effect size was determined using two articles reporting growth mindset manipulations with older populations from three separate studies (Plaks & Chasteen, 2013; Weiss et al., 2016). To the author's knowledge, these are the only published studies that have used a manipulation of mindset of aging (MA). Effect sizes were averaged across these three studies to obtain an average effect size $d=.56$ (Plaks & Chasteen, 2013, $d=.51$; Weiss et al., 2016, $d=.75$ (Study 1), $d=.41$ (Study 2)). This statistic was entered in G-Power with an alpha rate of 0.05 and with 0.7 power, as noted to be sufficient (Finkel, Eastwick, & Reis, 2017). The necessary sample size computed was 86. One hundred and thirteen participants were recruited from a community-dwelling sample of adults from the South East Idaho area aged 60 years and above. Participants resided between approximately 1 and 120 miles from the Idaho State University (ISU) campus, with some residing close to campus or in town, some in small towns in neighboring counties and others residing in larger surrounding cities. Two participants were excluded from further analysis due to suspected dementia (see cognitive status inclusion criteria below), and 25 were excluded due to failure to pass the manipulation check (see manipulation inclusion criteria below). Thus, the final sample size was 86, with 43 participants in both experimental groups (growth vs. fixed mindset).

Of the participants, the mean age was 66.72 years ($SD=5.43$; Range = 60-82), 52.3% were female, 97.7% were European-American, 1.2% were Asian, and 1.2% were African American. For education, 8.1% reported only a high school education (12 years), 30.2% had at least a 4-year college degree (16 years), and 28.2% had more than a 4-year college degree (over 16 years). In

addition, 43.3% indicated participation in continuing education courses within the past year, such as New Knowledge Adventures (NKA), online courses through ISU and other universities, or through other channels (e.g., church or local community center). Continuing education was defined as courses taken either online or in-person. Courses required to maintain employment or for employment-related certification were not considered to be continuing education. Recruitment of participants occurred through ISU networks which included NKA (an adult learning program geared towards adults of retirement age), postings on the ISU Facebook page, and through a local flyer. The flyer was posted across both the Pocatello and Idaho Falls campus message boards and in local businesses, such as coffee shops, restaurants, fitness centers, and in the local community senior center.

Human Subjects Committee approval was obtained from ISU in May 2018. Participants were debriefed, thanked and compensated for their time. Compensation was either \$10 cash or a \$10 Walmart gift card, and the testing session lasted approximately one hour.

Measures & Materials

Cognitive Status. The Mini-Mental State Examination (MMSE) assesses mental status, including orientation to time and place, immediate and delayed recall, attention and calculation, and language (Folstein, Folstein, & McHugh, 1975). This widely used dementia screen was used as a means of exclusion criteria for participants scoring 24 or below out of a possible 30 points as an indicator of suspected cognitive impairment. This was used to ensure that participants in the analyses were cognitively normal, and any effects found were not due to age-related cognitive impairment.

Mindset of Aging Manipulation. Participants were presented with an article either supporting the view that aging is malleable or fixed (see Appendix A & Appendix B, respectively),

depending on group assignment, and were asked to briefly summarize the article in their own words in no more than one paragraph. This reading comprehension task was a dummy task to ensure participants had read and understood the article, and the written paragraphs did not undergo analysis beyond one confirmatory reading. Participants rated (on 1-5 Likert scales: 1 = “Disagree”; 5 = “Agree”) the degree to which the article was “easy to understand,” “credible,” and “persuasive” (Appendix C). The articles and methodology were identical to those used in a previous study by Weiss et al. (2016). To ensure that the manipulation was successful, participants with an average score < “4” across all three items were deemed not to have endorsed the mindset manipulation and were subsequently excluded.

Mindset of Aging Measure. The Essentialist Beliefs about Aging scale (Weiss & Grah, 2014) was used to measure mindset of aging (See Appendix D). The scale includes four items designed to capture both ends of the growth versus fixed mindset of aging spectrum including: “To a large extent, a person’s age biologically determines his or her abilities”; “Age is just a number and doesn’t say much about a person.” Participants endorsed items on a Likert scale anchored from 1 = “strongly disagree” to 6 = “strongly agree.” The scale has been previously reported to have, on average, moderate to good psychometric properties (Cronbach’s $\alpha = .58$ & $\alpha = .65$; Weiss et al., 2016; Cronbach’s $\alpha = .73$, & $\alpha = .74$; Weiss, 2016) and in the present study, the psychometric properties were comparable (Cronbach’s $\alpha = .62$). Scores range from 4-24, with scores lower than 14 indicating a fixed MA and scores higher than 14 indicating a growth MA. A score of 14 indicates equal endorsement of both growth and fixed items, and therefore, a neutral MA.

Implicit Association Test. Implicit old-age attitudes were measured using the aging Implicit Association Test (IAT), which is a computer-based reaction times task used extensively in the past to quantify implicit attitude preferences for younger versus older faces (Greenwald et

al., 1998; Greenwald, Nosek, & Banaji, 2003; Nosek et al., 2002). Participants completed two blocks in which they responded to a series of pairings of either young or old face stimuli with negative or positive words and were instructed to work as fast as possible without making any errors. One block asked participants to pair positive stimuli with old faces and negative stimuli with young faces. The other block switched these pairings such that positive stimuli paired with young faces and negative stimuli paired with old faces. Scores were then derived from latencies (in seconds) of the responses to the two tasks and interpreted in terms of association strength. It is assumed that subjects respond faster to concepts and stimuli that they implicitly believe are closely associated. For example, should participants have close, negative unconscious associations with old age, then they would respond faster to negative words paired with old faces compared to positive words paired with old faces. Scores < 0 suggest negative implicit old-age attitudes.

Self-Perceptions of Aging. Self-perceptions of aging were assessed using the Image of Aging Scale (Levy et al., 2004) (see Appendix E). Participants were provided with a list of words (e.g., wise, fragile, senile, etc.) and asked to rate how much each word or phrase matches their image of themselves as an older person, on a scale from 0-6 (0 = “Does not match my image”; 6 = “Completely matches my image”). The scale comprises nine positive and nine negative age stereotype words. Reverse-scoring negative items and then summing all items together determined a total score ranging from 0-108. A higher score is indicative of more positive self-perceptions of aging. The Image of Aging scale has demonstrated good internal reliability previously (Cronbach’s $\alpha = .82-.84$; Levy, 2004), as well as in the present study (Cronbach’s $\alpha = .78$).

Age Identity. Along with participants’ real age, age identity was captured with one item (Westerhof & Barrett, 2005). The question states; “Many people feel older or younger than they

actually are. What age do you feel most of the time?” This question captured subjective age. The formula for obtaining age identity is:

$$\text{age identity} = \text{actual age} - \text{subjective age}.$$

A positive value denotes a youthful age identity, and a negative value represents an older age identity.

Working Memory. The Operation Span Task (OSPAN) (Turley-Ames & Whitfield, 2003; Turner & Engle, 1989) is a computer-based task that was used to assess working memory by having participants solve simple math problems while simultaneously remembering unrelated words following each math problem. Elements of the math problem were presented one at a time, and participants solved the problem verbally. Next, to-be-remembered words were presented, which were recalled at the end of each set. Set sizes increased from 2 to 6. A trial was marked incorrect if either the math equations were answered incorrectly or if the words were not remembered accurately. With a total of 60 trials, there were three sets of each series of operations and to-be-remembered words. The summation of correct trials equated to the working memory score, ranging from 0-60. The OSPAN has been shown to possess good psychometric properties previously (Cronbach’s $\alpha = .79$) across the three sets of each series, and be a valid indicator of working memory (Unsworth, Heitz, Schrock, & Engle, 2005).

Procedure

Before the testing day, participants were administered the Essentialist Beliefs of Aging scale via phone interview approximately one to fourteen days prior (herein referred to as pre-mindset of aging score; pre-MA). On the day of the testing session, participants entered the lab, completed, and signed consent forms. They were then randomly assigned to either the growth MA or the fixed MA group and were told that they would complete a reading comprehension task. This

element of deception was necessary to ensure that participants were not alerted to the mindset manipulation. Next, participants were given the appropriate manipulation article to read, pertaining to their randomly assigned group membership, followed by the dummy reading comprehension task, which acted as the manipulation check. The Essentialist Beliefs of Aging scale was administered for a second time (herein referred to as post-mindset of aging score; post-MA). The order in which participants completed the IAT, Image of Aging scale, and the Age Identity question were counterbalanced. Participants then completed the OSPAN. Lastly, participants were given a brief demographic questionnaire (Appendix F) and the MMSE. Participants were then debriefed, paid, and thanked for their time.

Statistical Analysis

Repeated-Measures Analysis of Variance. A 2 (manipulation: pre v post) x 2 (group: growth v fixed) repeated measures analysis of variance was conducted with mindset of aging (MA) scores as the dependent variable in order to determine whether there was an interaction between manipulation and group.

Post-hoc Analyses. Post-hoc analyses using independent samples *t*-tests and paired samples *t*-tests were conducted to determine whether MA scores differed between growth and fixed MA groups following the manipulation, and whether the manipulation was effective at influencing MA scores, respectively. Additionally, four one-sample *t*-tests were conducted in order to determine whether the growth and fixed groups differed on their pre- and post-MA scores from 14 (which indicates a neutral MA).

Multivariate Analysis of Covariance. A multivariate analysis of covariance (MANCOVA) was conducted with mindset group (growth and fixed) as the independent variable and implicit old-age attitudes (IAT), self-perceptions of aging (SPA), age identity, and working

memory (OSPAN) as the dependent variables. Age, sex, and education were considered as covariates. Age was determined to not be related to IAT ($r=-.053, p=.764$), SPA ($r=-.063, p=.567$) age identity ($r=.036, p=.743$) or OSPAN ($r=-.082, p=.770$). There were also no sex differences in IAT ($t(84)=-.624, p=.534$), SPA ($t(84)=-.819, p=.415$), age identity ($t(84)=.216, p=.829$) or OSPAN ($t(79)=-.293, p=.569$). Lastly, education did not relate to IAT ($r=-.033, p=.764$), SPA ($r=.029, p=.896$), or age identity ($r=-.204, p=.827$). However, education did relate to OSPAN ($r=.324, p=.003$) and was thus included as a covariate in the MANCOVA. Before running the MANCOVA analysis, the data were interrogated to ensure that all MANCOVA assumptions were met (French, Macedo, Poulsen, Waterson, & Yu, 2008).

Assumptions 1 & 2 – Multivariate normality and absence of outliers

Multivariate normality means that the means of the dependent variables are to be normally distributed within each group. IAT, SPA and OSPAN scores all displayed normal distributions (see Table 1), with all skewness and kurtosis values between -1 and 1 (Bulmer, 1979). IAT had two outliers, SPA had one outlier, and OSPAN had three outliers ($\leq 1.5x$ the interquartile range), all of which were retained as they were not extreme ($\geq 3x$ the interquartile range) and inclusion did not negatively influence normality.

Age identity displayed severe skewness and kurtosis, and contained four extreme outliers, thus violating the MANCOVA assumptions of normality and absence of outliers. Removal of the four outliers resulted in skewness of 1.09 ($SE=.266$) and kurtosis of 2 ($SE=.526$), which still fails to meet normality assumptions. Further iterations of outlier removal did not aid in the distribution of this measure approaching normality. Furthermore, the removal of the original four extreme

outliers resulted in the power to find effects as being deemed insufficient. Therefore, age identity was removed from the MANCOVA analysis.¹

Assumption 3 – Equal sample size and no missing data

The sample of 86 participants contained two even groups (growth vs. fixed), which was determined optimal for a MANCOVA with one independent variable (mindset group) and four dependent variables (IAT, SPA, age identity, and OSPAN). However, due to five missing OSPAN scores from the participant's inability to complete the task, the final sample size for the MANCOVA was 81, with 40 in the growth condition and 41 in the fixed condition. A recalculation of optimal sample size for a MANCOVA, using the same previously described average effect size ($d=.56$) and power of 0.7, with one independent variable (mindset group) and three dependent variables (IAT, SPA, and OSPAN) suggested the optimal number of participants for the MANCOVA was reduced to 78, meaning that the final sample size of 81 was ideal. Thus, although there was a small reduction in sample size, the power to find effects remained after the removal of five participants from the analysis due to missing OSPAN scores. Additionally, five missing items on the SPA questionnaire measure were imputed using mean substitution (Raaijmakers, 1999).

Assumption 4 – Homogeneity of variance-covariance matrices

Homogeneity of variance-covariance matrices assumes that the variance of the dependent variable is approximately the same at all levels of the independent variable (Nimon, 2012). As sample sizes were unequal due to the missingness of OSPAN scores, Box's Test of Equality of

¹ Following removal of extreme outliers and a square-root transformation, age identity reached acceptable normality, with skewness of $-.463$ ($SE=.269$) and kurtosis of $.869$ ($SE=.532$). However, with the removal of the four outliers (in addition to the removal of participants who did not complete the OSPAN task (see below)), the power to find effects was reduced to .61 which was deemed insufficient. Therefore, age identity was removed from further analysis. Note, a MANCOVA was conducted with the transformed age identity variable included as a dependent variable, and the results were not quantitatively nor qualitatively different from the MANCOVA with three dependent variables.

Covariance Matrices (or Box's M test) was examined to determine whether the data met the fourth assumption, homogeneity of variance-covariance matrices. Results showed that Box's M was not significant (Box's $M=3.452$, $F(6, 4514028) = .552$, $p = .769$), indicating that the data maintained robustness, meeting the fourth assumption.

Assumptions 5 and 6 – Linearity and absence of multicollinearity

Linearity assumes that the dependent variables and covariates in the data are linearly related, while the absence of multicollinearity assumes that there are no high correlations among the dependent variables (Tabachnick & Fidell, 2007). Potential covariates of age, sex, and education were examined and only education was determined to relate linearly to OSPAN scores ($r = .324$, $p = .003$). Pearson's r correlation analyses revealed that there were no issues with multicollinearity, as the dependent variables were uncorrelated (all $ps > 0.08$), OSPAN and IAT ($r = -.001$), OSPAN and SPA ($r = -.180$), SPA and IAT ($r = .001$).

Therefore, with the exception of age identity that was removed from the MANCOVA, the three remaining dependent variables, IAT, SPA and OSPAN, met all MANCOVA assumptions.

Multiple Regression. In keeping with prior studies (Chiu et al., 1997; Dweck, 2012; Dweck et al., 1995; Molden & Dweck, 2006; Weiss, 2016; Weiss et al., 2016; Weiss & Weiss, 2016), the data were further interrogated using post-MA scores, which were previously utilized as the independent variable in the present study, as a continuous outcome variable. In order to more closely match the structure of the MANCOVA, which allowed for all of the variables of interest to be examined in one model, multiple regression was determined to be appropriate for examining the relationship between post-MA, IAT, SPA, and OSPAN. Conducting a single multiple regression analysis in which post-MA scores are the outcome variable and IAT, SPA, and working memory are the predictor variables allows for examination of the unique variance of each predictor

in the model while controlling for the other variables. This examination would not be possible if three separate linear regression analyses were conducted with post-MA as the predictor and IAT, SPA, and working memory as single outcome variables. Furthermore, while it would intuitively seem that post-MA scores should be used as a predictor variable (thus mirroring the structure of the MANCOVA), multiple regression results are unable to imply causation and therefore, the order in which the variables are placed (i.e. post-MA as the outcome and the remaining variables as predictors) is not of importance. Thus, multiple regression was used with three predictor variables (IAT, SPA, and OSPAN), one outcome variable (post-MA scores), and one covariate (education). Given that there were no exclusions based on the manipulation check, this increased the sample size ($N = 111$). However, eight participants were excluded due to missing OSPAN scores, bringing the total to 103 participants included in the final regression model. Using G-Power (Erdfelder, Faul, & Buchner, 1996), the optimal sample size for a multiple regression with three predictor variables, alpha of .05, power of .7, and a small effect size of .11, was determined to be 80. Thus, the current sample of 103 was acceptable. The data were first tested to ensure that they met the three assumptions for multiple regression.

Assumption 1: Linearity

The first assumption of multiple regression is linearity, suggesting that the relationships between the outcome variable(s) and predictor variable(s) are linear (Fox, 1991; Kelley & Bolin, 2013). The scatterplots suggested a linear relationship; thus this assumption was met.

Assumption 2: Normality

The second assumption is that both predictor and outcome variable(s) are continuous and normality distributed. Post-MA was normally distributed, and the three outcome variables remained normally distributed (as described in Assumption 1 for MANCOVA) with the inclusion

of the 17 participants that were excluded from the MANCOVA analysis due to failing the manipulation check.

Assumption 3: Homoscedasticity

The final assumption of multiple regression is homoscedasticity, which means equal variances across the predictor variables. The present data met this assumption, as made evident with the scatterplot of residuals and predicted values, which suggest relatively equal variance across the predictor variables.

Sensitivity analysis. An identical multiple regression analysis was conducted on the three predictor variables (IAT, SPA, and OSPAN), and one covariate (education), but using pre-MA scores as the outcome variable. This was to ensure that the relationship between mindset of aging and the outcome variables of interest was accurately captured. The results of this sensitivity analysis were neither qualitatively nor quantitatively different to the original multiple regression analysis using post-MA as the outcome variable. Therefore, the results using pre-MA scores were not considered further.

Non-parametric Tests. Given that age identity did not meet the assumption of normality, a Mann-Whitney U Test was conducted in order to examine any potential differences in age identity scores between growth and fixed MA groups following the manipulation. Furthermore, a Spearman's rho correlation was used to illuminate the relationship between age identity and post-MA scores.

Chapter 3: Results

Repeated-Measures Analysis of Variance

The main effect of manipulation was not significant ($F(1, 83) = 1.272, p = .263, \eta_p^2 = .015$) nor was the main effect of group ($F(1, 83) = 3.137, p = .08$). However, a significant interaction between manipulation and group emerged ($F(1, 83) = 14.96, p < .001, \eta_p^2 = .153$), displayed in Figure 1.

Post-hoc Analyses

Post-hoc analyses using an independent samples *t*-test revealed that before the manipulation, as expected, the growth group ($M = 17.44, SD = 3.74$) did not differ significantly from the fixed group ($M = 17.83, SD = 3.70; t(84) = .486, p = .628$) on pre-MA. Following the manipulation, however, the growth group ($M = 19.40, SD = 2.74$) demonstrated significantly higher post-MA scores than the fixed group ($M = 16.70, SD = 3.50; t(84) = -4.01, p < .001$), indicating that the manipulation was successful in influencing MA scores in the expected direction.

Paired-samples *t*-tests further confirmed that the manipulation was successful as MA scores increased significantly in the growth group ($t(42) = 3.318, p = .002$) and decreased significantly in the fixed group ($t(41) = -2.089, p = .043$) following the manipulation.

Four one-sample *t*-tests determined that pre- and post-MA for each group (growth v fixed) differed from the midpoint score of 14, which represents endorsement of a neutral MA. Specifically, all four scores were significantly higher than 14 (all $ps < 0.05$), indicating that, on average, participants both pre-and post- MA manipulation endorsed more of a growth MA.

Multivariate Analysis of Covariance

Results from the MANCOVA indicated that there was not a statistically significant difference in IAT, SPA, or OSPAN scores based on mindset group ($F(3, 76) = .149, p = .93$; Wilk's

$\Lambda = 0.994$, partial $\eta^2 = .006$). In other words, mindset group membership did not influence scores on any of the outcome variables.

Multiple Regression

The regression results revealed that the overall model was significant ($F(3, 99) = 5.62$, $p = .001$, $R^2 = .145$). Specifically, post-MA scores were positively related to IAT ($\beta = 2.383$, $p = .003$) and to SPA ($\beta = .084$, $p = .006$; see Figure 2), but not to OSPAN scores ($\beta = .01$, $p = .763$).

Non-parametric Tests

An independent samples Mann-Whitney U Test determined that there was no difference between growth ($Mdn = 11$) and fixed ($Mdn = 12$) MA groups on age identity ($U = 816.50$, $p = .350$). A Spearman's rho determined that there was no statistically significant relationship between age identity and post-MA scores ($\rho = .047$, $p = .627$).

Chapter 4: Discussion

Implications and Strengths

This novel study was the first to examine the influence of mindset of aging (MA) on implicit old-age attitudes, self-perceptions of aging (SPA), age identity, and working memory in a population of rural, community-dwelling older adults. In line with previous research (Weiss et al., 2016), MA was able to be manipulated. However, unlike previous research, the manipulation of MA was not a mechanism by which the dependent variables were influenced. Interestingly, relationships were discovered between MA and implicit old-age attitudes and MA and SPA. Specifically, having more of a growth MA was related to less negative implicit old-age attitudes and more positive SPA.

The mindset literature has previously demonstrated that different types of mindset are subject to manipulation (Aronson et al., 2002; Blackwell et al., 2007; Plaks & Chasteen, 2013). However, MA, specifically, has only been examined in three publications to date (Weiss, 2016; Weiss et al., 2016; Weiss & Weiss, 2016), with only one of these studies using a causal methodology to address MA's influence on psychological outcomes (the other two used correlational methods). The study that used experimental methods, which the present study sought to replicate, demonstrated that MA could be manipulated, with the fixed group displaying lower mindset scores than the growth group, indicating more of a fixed MA (Weiss et al., 2016). In the current study, MA was also able to be manipulated, as scores displayed significant changes in the appropriate directions following the manipulation. However, MA scores in the present study indicated that all group averages represented more of a growth MA. To explain, scores lower than 14 suggest more of a fixed MA, scores higher than 14 suggest more of a growth MA, and scores of exactly 14 suggest endorsement of a neutral MA. The current findings indicated that scores for

both the growth and fixed groups, both before and after the manipulation, were all significantly higher than 14 and thus demonstrated more of a growth MA, on average. Altogether, the significant difference between groups after the manipulation in the present study demonstrated a difference between low-end and high-end growth MA rather than an absolute growth and fixed MA. This finding supports the notion that MA beliefs fall on a spectrum, or continuum, regarding the malleability of the aging process rather than a dichotomous (i.e. growth or fixed) endorsement. This further supports the results of the regression analyses that used MA beliefs as a continuous variable.

Whether the lack of a true fixed MA group is reflective of previous research is unknown, as no threshold, or cut-off points, between growth and fixed MA were reported in the previous experiment which the present experiment sought to replicate (Weiss et al., 2016). Nonetheless, the results from Weiss et al. (2016) demonstrated that adults primed with a fixed MA reported a more limited future time perspective as well as increased age-related threat. In contrast, the current study did not find that manipulating MA influenced implicit old-age attitudes, SPA, age identity, or working memory. However, because the post-MA scores were indicative of more of a growth mindset in both groups, this may explain why there were no group differences on the outcomes of interest. Implicit attitudes (Devine, Forscher, Austin, & Cox, 2012), SPA (Wolff, Warner, Ziegelmann, & Wurm, 2014), age identity (Stephan et al., 2012), and working memory (Buschkuehl et al., 2008; Hess et al., 2004; Levy, 1996; Plaks & Chasteen, 2013; Zinke et al., 2014) have shown to be altered through manipulations or interventions, so it may be the case that the current MA manipulation was not strong enough to produce an effect on these outcomes. It is possible that with a stronger manipulation, one that placed individuals into a true ‘fixed’ MA, and that created a greater split between growth and fixed mindset scores, there would have been group

differences in implicit old-age attitudes, self-perceptions of aging, age identity, and working memory scores.

The present study did discover that greater growth MA scores were associated with less negative implicit old-age attitudes. The only known previous research on mindset and implicit attitudes found that mindset of prejudice was unrelated to implicit race-attitudes (Carr et al., 2012). Thus, the current finding is the first to demonstrate a relationship in the literature between mindset and implicit attitudes. Furthermore, the present study is the first to examine the relationship between MA and implicit old-age attitudes in any population, let alone an older population, which is of interest as negative old-age attitudes are often found within older adults (Axt, Ebersole, & Nosek, 2014; Chopik & Giasson, 2017; Hummert et al., 2002; Levy, 2001). It is also important to restate that implicit old-age attitudes are outside of conscious awareness or control (Greenwald & Krieger, 2006), meaning that while an older adult may explicitly report having positive old-age attitudes, they may implicitly believe otherwise. In other words, older adults may be unaware of the negative implicit old-age attitudes they hold towards their same-aged peers and therefore, may be unaware of discriminatory behaviors they are engaging in, such as avoidance (Chen & Bargh, 1999). Furthermore, negative implicit old-age attitudes relate to behavior in some healthcare settings such that older adults often go undertreated by physicians (FitzGerald & Hurst, 2017; Protière, Viens, Rousseau, & Moatti, 2010). For this reason, it is critically important to adjust these attitudes such that more positive, rather than negative, implicit old-age attitudes are the norm. While more experimental research needs to be conducted on this relationship to determine causality, the results from the current study present preliminary evidence that a growth MA should be promoted such that negative implicit old-age attitudes may be decreased in the general population.

The present research additionally provided evidence for the notion that having more of a growth MA relates to more positive SPA. As mentioned previously, the MA literature is limited, and this particular relationship had not been explored in the past. This finding is critically important because SPA relate to several other important health and psychological outcomes. For example, prior studies have found that having positive rather than negative SPA relate to better performance on memory tasks, specifically free-recall (Levy & Langer, 1994), higher life satisfaction (Kiaeripour et al., 2017), and an average of 7.5 longer years lived (Levy et al., 2002b). Therefore, positive SPA relate to beneficial cognitive, health, and wellness outcomes. Although the present finding is not causal, it is still important as it provides pathways for this relationship to be explored in more depth in future studies. As with the present findings between MA and implicit old-age attitudes, promoting more of a growth MA may help to promote positive SPA. Additionally, it would behoove future studies to examine whether MA relates to other health and wellness outcomes; for example, life-satisfaction, objective and subjective health, and longevity, in order to further understand the positive benefits to endorsing more of a growth MA.

Previous studies have found that a younger age identity relates to some of the same outcomes as SPA, such as physical and psychological health (Bowling et al., 2005). Furthermore, previous research has shown that a younger age identity is related to more positive SPA (Kotter-Grühn et al., 2009). It is interesting, then, that post-MA was not found to be related to age identity scores. It is possible that the measurement used can explain this difference in findings. To explain, the present study utilized a single-item measure of age identity while other studies have utilized domain-specific measures of age identity which assess subjective feelings about age-related appearances, subjective age, socially appropriate age-related behaviors, and appraisal of interests as socially “old” or “young” (e.g., love for cartoons) (Kastenbaum, Derbin, Sabatini, & Artt, 1972).

Therefore, these measures are able to capture additional aspects of age identity beyond subjective age, which arguably constitutes a more valid measure. Thus, future work should examine MA with age identity using a domain-specific measure to further illuminate the relationship between the two variables.

With regards to memory, previous research has found that MA moderates the impact of negative age-related stereotypes (i.e., stereotype threat) on older adult's free-recall memory performance (Weiss, 2016). Specifically, those who endorsed a higher growth MA were not as impacted by negative age-related stereotypes and outperformed those who endorsed less growth MA beliefs. Additionally, previous research has found that mindset of *memory* is subject to manipulation and influences performance on free recall and working memory tasks (Plaks & Chasteen, 2013). The results of the present study, however, demonstrated that there was neither an influence of, nor a relationship between, MA and working memory performance. While free recall memory was not examined, working memory was assessed with the operation span task (OSPAN), which is a similar working memory measure to the reading span task used previously in the mindset of memory research. It is possible then, that the reason MA in the current study (unlike mindset of memory in previous research) was not influential in changing working memory scores, is that the MA belief system encompasses multiple aspects of aging whereas mindset of memory applies only to memory ability. Therefore, the manipulation used in the prior mindset of memory research may be more salient for participants, and thus, more influential for working memory performance. Nonetheless, the current study was the first to examine working memory with MA and is, therefore, an important addition to the literature.

To summarize, MA related to both implicit old-age attitudes and explicit SPA. This finding supports the notion that MA relates to outcomes both in- and outside of conscious awareness or

control, which is important, because past research demonstrates that implicit and explicit attitudes are not always synchronous (Lambert et al., 2013). Examining both implicit and explicit constructs is a strength of this work. There are several other strengths. The methods in the present study were improved and expanded upon from prior research. To explain, the present study required participants to be at least 60 years of age, while the previous research by Weiss et al., (2016) did not exclusively examine MA in older adults, but in adults aged 22-77 years. Additionally, MA was not measured before the manipulation in the Weiss et al., (2016) work, which was accomplished in the current study and allowed for comparison between pre-and post- manipulation MA scores. In doing so, the present research demonstrated that scores significantly changed in the correct directions following the manipulation in each group. Furthermore, in the previous research the MA scoring system varied across three different studies with little transparency of the methodology, and there was no manipulation check or subsequent exclusionary criteria to ensure participants understood the manipulation articles (Weiss et al., 2016). In the present study the methods were transparent, replicable, and contained a manipulation check, thus increasing internal validity. Lastly, most research on aging is carried out in urban environments, yet most of the United States' population of aging adults reside in rural areas (Baernholdt et al., 2012), therefore, rural populations are underrepresented in aging research. The present research was the first experiment to examine MA in an understudied, rural population of older adults in the United States.

Limitations

There were several limitations in the present experiment. Firstly, as mentioned previously, the MA manipulation was not strong enough to place participants randomly assigned to the fixed group into a truly fixed MA, but rather into a lower-level growth MA in comparison to the growth MA group. This lack of a true fixed MA group likely impacted any between-group differences on

the outcomes of interest. Had the manipulation been able to produce a true fixed MA group, there may have been group differences observed. It is also worth noting that the vast majority of manipulation check exclusions (25 out of 27) in the sample were due to participants in the fixed mindset condition failing to pass the manipulation check, which suggests that they did not believe the manipulation article. As the results from the pre-manipulation scores demonstrated, the entire sample, on average, entered the study with more growth MA scores, meaning that more of a growth MA was present before any manipulation took place. In other words, they did not enter the study, on average, from a neutral MA perspective. Taken together, the results from this study and at least one prior study (Weiss et al., 2016) provide evidence for the notion that some older adults tend to hold more of a growth MA, on average, meaning that they believe they can potentially alter their aging process. Although this population trend was not amenable to experimental manipulations, it is generally encouraging that the few studies examining MA have illuminated that older adults tend to harbor the belief that how they age is malleable and that they may influence it. Previous research from several decades ago found that older adults tend to view late-life development as multifaceted and are fairly optimistic about influencing how they age (Heckhausen & Baltes, 1991; Heckhausen, Dixon, & Baltes, 1989). It is interesting to note that the present study displayed similar findings, and this might explain why the older adults in previous work and in the current study reported more growth over fixed mindsets of aging.

Secondly, the age identity measure was unable to be included in the main analysis. While the method for capturing age identity has been successfully used previously (Westerhof & Barrett, 2005), the measure was too unstable in the current study. The skewness and kurtosis were non-normal even after removal of outliers. However, despite the non-normality of the measure in the

current study, subjecting the data to non-parametric analyses allowed for the examination of age identity with MA, which revealed no relationship between the two.

Third, the sample was 96.4% European American and approximately 30% had at least a bachelor's degree. In 2018, 60.7% of adults in the United States reported to be European American (US Census Bureau, 2018) and a 2017 report of educational attainment in the United States stated that of adults aged 55 years and over, 18% reported having a bachelor's degree (US Census Bureau, 2017), making the present sample far less racially diverse and more educated than the general population of the United States. This implies that the results of the present study lack external validity, and instead are generalizable to predominantly European American, well-educated older adults. Additionally, the present sample was primarily recruited through avenues that support continuing education (i.e. NKA, which is an adult education curriculum within ISU with over 80 course options) and thus recruitment strategies targeted an audience that has an interest in the activities of a university. It is possible then, that these educational characteristics are partially responsible for the finding that the majority of participants endorsed more of a growth MA pre-and-post manipulation. For example, while 43.2% of respondents reported participating in continuing education, it is possible that the remaining 56.8% were exposed to educational information that they would not typically be exposed to did they not live in communities surrounding a university campus (e.g., free aging-related seminars in senior centers). This may have influenced the outcomes of the present study because the important influence of lifestyle factors on aging may have been discussed more frequently than in rural environments that are not close to university campuses. Furthermore, living in close proximity to a university may have allowed for higher rates of interaction with younger family members (i.e., children and grandchildren), or younger people in general in attendance at the university. Therefore, even if the

participants were not typically active in the local community or senior center, knowledge regarding the importance of lifestyle factors influencing the aging process could have been passed along to the older participants in the current study by family members seeking out a higher education, or by greater exposure to students in general.

Last, the present manipulation and measure of MA may have been tapping into something previously unconsidered: the classic nature versus nurture debate of development. For example, the fixed MA manipulation described genetic components as the primary influence over how one ages, i.e., nature; while the growth MA manipulation described lifestyle factors as the primary influence, i.e., nurture. The measure of MA, as used by previous research (Weiss, 2016; Weiss et al., 2016; Weiss & Weiss, 2016), asked participants to endorse statements reflective of these nature versus nurture depictions of aging. Given that all participants in the present study were at least 60 years old at the time of testing, and were likely raised during an era in which the dominant notion was that of nature and nativism playing the strongest role in development (Sameroff, 2010), these results are all the more interesting. One may assume that the historical context in which the participants were raised as children would have shaped them to endorse more of a fixed MA as it is more reflective of nativist ideas. However, as discussed, participants in the present study endorsed more of a growth MA overall. Perhaps the higher levels of education of the sample (58.4% having 16 years or higher) allowed for more exposure to nurturist theories, which describe the now well-studied interactions between nature and nurture (Gottlieb, 1998, 2007; McCrae et al., 2000; Plomin, 1994; Rutter, 2006), which led to a shift in thinking. Thus, education levels may provide some explanation as to why the growth MA belief was so prevalent in this sample of older participants.

Future Directions

There are some future directions which may be pursued following the results of this study, especially given the present MA literature is limited. One suggestion is that future studies should examine whether MA has predictive power with the use of a longitudinal design. Given that SPA can be predictive of functional health nearly two decades later (Levy et al., 2002a), it is possible that MA also possesses predictive utility, and should be examined in young and middle-aged adults as a potential indicator of future psychological outcomes. Furthermore, previous research demonstrates that more positive SPA relate to healthy and successful aging, so it may be the case that MA acts in a similar way. Therefore, self-rated and objective measures of physical health are important to capture in relation to MA in order to determine how, like SPA, these constructs relate to each other. It may be the case that more of a growth MA relates to healthier lifestyle choices, given that these are viewed as aspects of aging which are more malleable (as opposed to increasing chronological age, which is not malleable). Importantly, future studies should examine whether MA relates to other aspects of cognition, as only working memory was examined in the current study. Of particular interest is a different component of executive function, inhibition, which is the ability to ignore both internal and external intrusive, irrelevant information (Hasher & Zacks, 1988; Shao, Janse, Visser, & Meyer, 2014). This aspect of executive function is of interest in relation to MA as it is susceptible to age-related decline (McCarrey et al., 2016), and plays a role in successful social functioning (Henry, von Hippel, & Baynes, 2009). Previous research has found that older adults who performed poorly on tasks of inhibition were more likely to engage in socially inappropriate behaviors, such as failing to restrain prejudice behaviors (von Hippel, Silver, & Lynch, 2000) and negative responses to unappealing food offerings (von Hippel & Gonsalkore, 2005), as well as inappropriate discussion of private events in public settings (von Hippel &

Dunlop, 2005). These inappropriate behaviors can lead to social exclusion and increased loneliness, which older adults are already susceptible to (Pinquart & Sörenson, 2001), with higher levels of loneliness related to increased health risks (Cornwell & Waite, 2009). Therefore, while MA did not relate to working memory in the present study, it is crucial to examine whether a growth MA positively relates to other cognitions such as inhibition which is important for social functioning and well-being in older adults. Such a finding may provide further evidence for the benefit of growth MA. Finally, MA should be explored in a more representative population of older adults in the United States (i.e., with more variability in educational attainment) in an attempt to increase the generalizability of these results. It may be the case that for those with lower levels of educational attainment (e.g., middle school or high school only), the relationship between MA, implicit old-age attitudes and SPA would differ from the present sample. Differing levels of education may influence MA endorsement, as those with lower levels of education may utilize close others, such as family, or the media as primary sources for information on aging rather than through formal education practices. It is possible then, that participants from this demographic may endorse more of a fixed MA, believing in a genetic destiny which resembles their relatives, rather than endorsing a growth MA. Additionally, previous research demonstrates that lower levels of education relate to more negative implicit attitudes (Anderson & Ferguson, 2017) and more negative SPA (Löckenhoff et al., 2009). Therefore, sampling from a population with lower levels of education may result in greater endorsement of a fixed MA, and thus more negative implicit old-age attitudes, and more negative SPA. Additional recruiting methods may help to achieve a more diversified sample, as the present study recruited participants through avenues which support continuing education for older adults, such as NKA, and those who follow the ISU Facebook page or have relatives who follow the page. Some examples of strategies that might provide a more

representative sample include recruiting from local healthcare centers that are not in close proximity to university or community college campuses (e.g., general practitioners, urgent care, etc.), as this may aid in recruiting older adults who are not as active in the campus community or do not use computers or applications such as Facebook. Additionally, online testing strategies such as Amazon Mechanical Turk should be utilized as it allows for participants from many populations and environments across a nation to participate, provided they are active in using computers for internet use. Ultimately, recruiting a national sample of older adults would allow for a clearer image of the relationships between MA, implicit old-age attitudes, and SPA to emerge.

Conclusions

In conclusion, past research within the mindset literature has demonstrated how beneficial endorsing more of a growth mindset is, whether it be in intelligence (Blackwell et al., 2007), personality (Dweck et al., 1995), or attitudes towards an outgroup (Dweck, 2012). The present study has provided additional evidence for the benefit of growth mindset by illuminating the positive outcomes related to a growth mindset of *aging*. The results of the present study are a substantial addition to both the mindset and aging literatures, and demonstrate a relationship between mindset of aging and implicit old-age attitudes and self-perceptions of aging, and an absence of association between mindset of aging and age identity and working memory. This is the first study to examine these relationships and provides pathways for future research to better examine mindset of aging as a potential protective factor for health and wellness in older adulthood. In a world rapidly growing older, it is critical to find ways to improve the lives of aging citizens, and the present results demonstrate that having more of a growth mindset of aging may be one way achieve this goal.

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Table 1. <i>Descriptive Statistics of Variables of Interest</i>						
Measure	M	SD	SE	Range	Skewness	Kurtosis
Implicit Old-age Attitudes	-.554	.399	.043	(-1.4-.552)	.550	.217
Self-perceptions of Aging	84.56	11.41	1.23	(51-105)	-.404	-.058
Age Identity	16.12	15.12	1.63	(-4-73)	2.024	4.764
Working Memory	29.11	9.11	1.01	(7-54)	.170	.575
<i>Notes.</i> N=86 for Implicit Old-age Attitudes, Self-perceptions of Aging, & Age Identity; N=81 for Working Memory.						

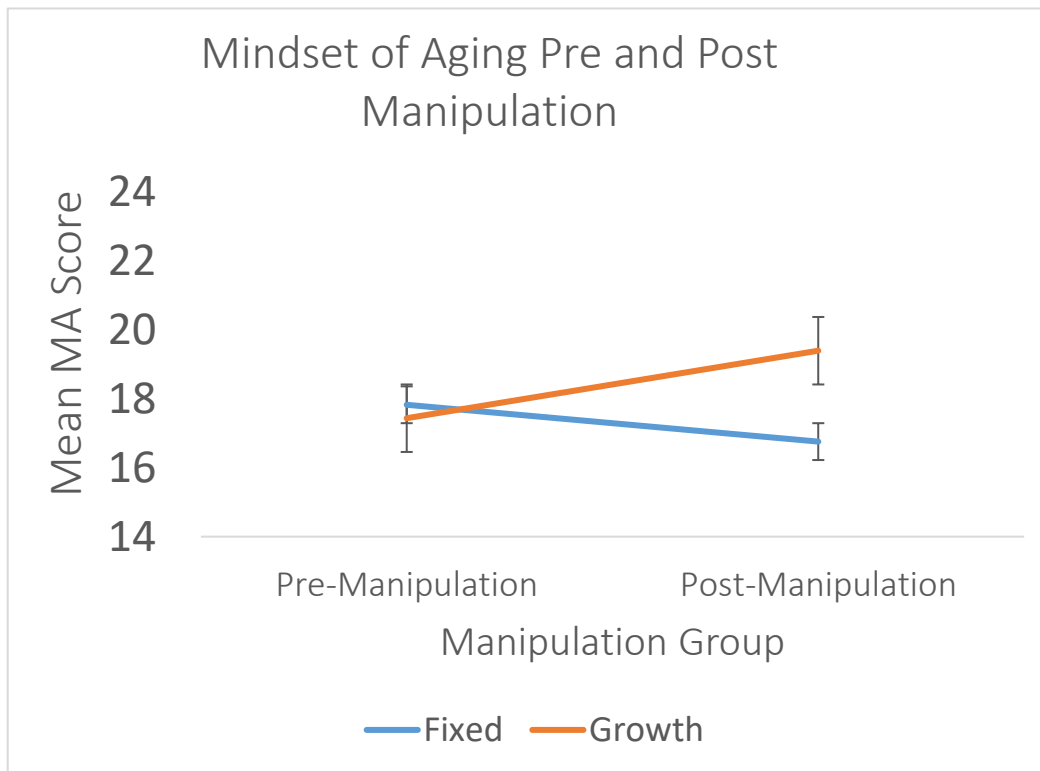


Figure 1. Mindset of Aging Scores Pre- and Post-Manipulation.

MA = Mindset of Aging

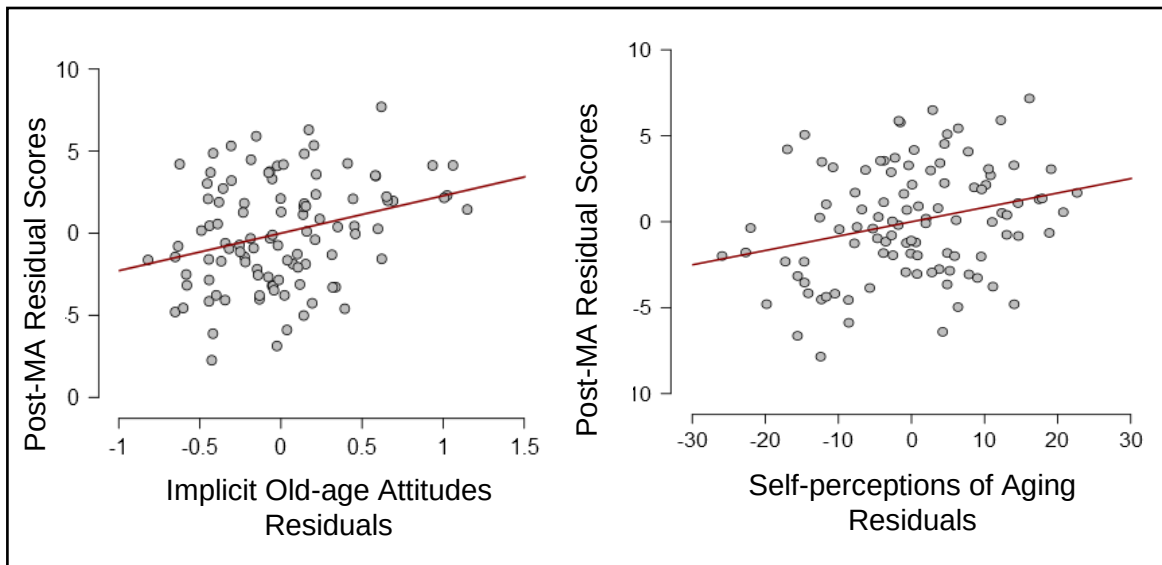


Figure 2. Multiple Regression Residual Plots of Significant Results.
Post-MA = Mindset of Aging scores after the manipulation.

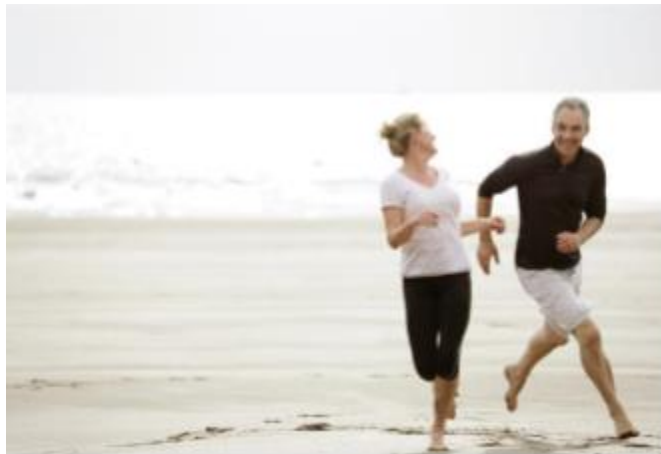
Appendix A

Mindset of Aging Manipulation – Growth Mindset of Aging Condition

Age is Just a Number

Aging | *Lifestyle choices are more important than you might think*

S.T. Fettererson



Aging is an inevitable part of life. However, there are still things we can do to slow down the aging process, or at least to ensure that we remain as mentally and physically fit as we possibly can over time. Though no one theory can explain the aging process completely, recent research findings have

shown support for the concept of lifestyle choices as the most central factor of aging.

Scientists can guess people's lifespans by looking at their lifestyles

Genes play a role in aging well, but they are not nearly as important as you might think. Instead, it is how we live our lives that determines how we age and how old we will get. Early studies on aging reported that only a quarter to a third of the variation in aging and longevity is accounted for by genes, and even that is likely an overestimate of direct biological effects. The journal *Genes and Development* recently published a study in which scientists compared the relative influence of people's genes and habits on the human lifespan. These Harvard University scientists were able to make accurate estimates of age and longevity when taking information about people's habits into account (e.g., diet, physical activity, and living situation).

Lifestyle choices matter

The study also suggests that today, people live around 30 years longer than they did 100 years ago. “We are healthier, more active, and we have a higher standard of living,” says Professor Gilbert, who conducted the study in his laboratory at Harvard University. He concludes that “the essential conditions for healthy aging and a long life are a well-balanced mental state, correct nutrition, and physical activity.”

How we age is shaped by our personality and behavior

This new evidence demonstrates that lifestyle choices can play an increasingly strong role in buffering many of the physiological changes linked to aging. The *Genes and Development* study provides novel insights showing that mental and physical productivity can indeed be increased even in old age: Negative lifestyle choices (such as drinking, smoking, lack of exercise, and stress) definitely accelerate aging while positive lifestyle factors (including healthy eating and exercise) have the opposite effect. In light of the scientific consensus that lifestyle is central in the aging process, Professor Gilbert provides some practical advice: “Being able to handle the physical ailments that come with age and making the most of our remaining abilities requires openness, acceptance, and a touch of humor. Never forget –age is nothing more than a number.”

Appendix B

Mindset of Aging Manipulation - Fixed Mindset of Aging Condition

Aging Process is set in Stone

Aging | *Genes are more important than you might think*

S.T. Fetterson



Aging is an inevitable part of life. A new study suggests that we are genetically "programmed" to live a natural lifespan and that this programming is based on internal "markers" that determine how we age and how long we live. Though no one theory can

explain the aging process completely, recent research findings have shown support for the concept of genetic makeup as the most central factor of aging.

Scientists can guess people's lifespans by looking at their genes

Genes play a role in aging well, and they are more important than you might think. A new study published in the journal *Genes and Development* demonstrates that we have a genetic "clock" that controls the age at which we experience the different stages of aging. Although early studies on aging reported that at least a quarter to a third of the variation in aging and longevity is accounted for by genes, this is likely an underestimate of direct biological effects. In a recent study, which was conducted at Harvard University, scientists compared the relative influence of people's genes and habits on the human lifespan. By looking at a network of genes, they were able to accurately estimate a person's age as well as predict how much longer the person would live.

Genes matter

This study provides novel insights showing that how we age is shaped by the genes we acquire from our parents. “It is our biology that determines how we age and how old we will get,” says Professor Gilbert, who conducted the study in his laboratory at Harvard University. He concludes that “the essential conditions for healthy aging and a long life are good genes.”

How we age is shaped by our genes

This new evidence demonstrates that genes play an increasingly strong role in how we age. According to the *Genes and Development* study, a network of about 750 genes is responsible for aging and life expectancy. Mild DNA damage transferred from the mother contributes to the aging process. The findings suggest that some people are genetically programmed to age more quickly, which explains why people with a certain combination of genes live longer lives regardless of their country of origin. In light of the scientific consensus that genes are central in the aging process, Professor Gilbert concludes, “The aging process is set in stone: It’s definitely the sum of our genetic material that has the biggest impact on aging.”

Appendix C

Your first task is focused on reading comprehension based on a newspaper article. Once you have completed the reading, we ask that you summarize what you have read in your own words on the following lines in no more than one paragraph. Next we ask that you answer three questions regarding comprehension of the article.

This image shows a single sheet of white paper with horizontal blue ruling lines. The lines are evenly spaced and run across the width of the page. There are no margins, text, or other markings on the paper.

Please rate the degree to which you agree or disagree with the following statements.

		Disagree	Somewhat disagree	Neither agree nor disagree	Somewhat agree	Agree
1.	The article was easy to understand.	1	2	3	4	5
2.	The article contained credible information.	1	2	3	4	5
3.	The article was persuasive.	1	2	3	4	5

Appendix D

Please rate the extent to which you agree or disagree with the following statements, taking into consideration the article that you just read and how you are feeling *right now at this very moment*.

1. To a large extent, a person's age biologically determines his or her abilities.

1	2	3	4	5	6
Strongly Disagree				Strongly Agree	

2. Aging is an irreversible biological process and cannot be influenced.

1	2	3	4	5	6
Strongly Disagree				Strongly Agree	

3. Age is just a number and doesn't say much about a person.

1	2	3	4	5	6
Strongly Disagree				Strongly Agree	

4. No matter at what point in life, you can always influence your own aging.

1	2	3	4	5	6
Strongly Disagree				Strongly Agree	

Appendix E

Directions: I am interested in knowing when you think of **yourself as an older person** in general, how much the following words match the images or pictures that you have. There are no right or wrong answers. After each word or phrase, please circle the number from 0 to 6 that best shows how well the word matches your image or picture of **yourself as an older person** in general with 0 being furthest from what you think and 6 being closest to what you think.

0-----1-----2-----3-----4-----5-----6

Does not match
my image

Completely
matches my
image

a. healthy	0	1	2	3	4	5	6
b. wrinkled	0	1	2	3	4	5	6
c. family-oriented	0	1	2	3	4	5	6
d. grumpy	0	1	2	3	4	5	6
e. capable	0	1	2	3	4	5	6
f. dying	0	1	2	3	4	5	6
g. active	0	1	2	3	4	5	6
h. senile	0	1	2	3	4	5	6
i. positive outlook	0	1	2	3	4	5	6
j. given up	0	1	2	3	4	5	6
k. well-groomed	0	1	2	3	4	5	6
l. walks slowly	0	1	2	3	4	5	6
m. alone	0	1	2	3	4	5	6
n. will-to-live	0	1	2	3	4	5	6

o.	helpless	0	1	2	3	4	5	6
p.	wise	0	1	2	3	4	5	6
q.	sick	0	1	2	3	4	5	6
r.	full of life	0	1	2	3	4	5	6

Appendix F

Demographics

Gender: Male / Female Date of birth: ____/____/____ Age: _____

Marital status _____

Cultural Origins: ☐ European-American ☐ Hispanic ☐ African-American ☐ Asian
☐ Native American ☐ other _____

How many years of full-time education have you had?(for example, if you graduated high school and did no further study that would be 12years; if you graduated high school and did a 4-year college degree that would be 16 years). Number of years of education: _____

Retired: ☐ Yes ☐ No If yes, for how many years: _____

Occupation (before retirement): _____

Weekly household income: ☐ < \$500 ☐ \$500 -\$1000 ☐ \$1000 -\$2000 ☐ > \$2000

Hobbies you participate in weekly: _____

Head Injuries: _____

Stroke/Cardiovascular events (e.g. Heart attack): _____

Are you currently taking prescription drugs? ☐ Yes ☐ No If yes, what for?

How many times have you been to see a doctor or a health professional in the last month? _____

How tired do you feel currently?

1 2 3 4 5 6 7

Extremely tired somewhat tired Not tired at all

Have you ingested the following in the last hour? ☐ Coffee ☐ Cigarette ☐ Alcohol ☐ Drugs

Do you ever participate in any continuing education courses? If so, where and how often?
