

The Impact of Education on the Cognitive Abilities and  
Well-Being of Older Americans

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## **Abstract**

Recent research shows higher education, whether obtained before or after the commencement of retirement, leads to enhanced post retirement cognitive abilities and satisfaction, as well as material increases in the possibility of career level compensated employment. Employment, especially “option 2 career” type employment, is a primary facilitator and driver of continued senior social engagement.

Since current theory suggests that continued senior social engagement in society is a pivotal facilitator and the primary basis for increased well-being and longevity of life, this is a very important topic to older Americans. It is also an important subject for legislative senior policy developers, as well as higher education academic institutions, if they are to grow and further develop a growth strategy aligned with the cognitive and well-being needs of older Americans.

With life expectancy continuing to increase, seniors currently reaching age 60 years old are now expecting to live another 20 to 30 years. As a result, they feel the need for a “Third Age”, where continuing higher education, enhanced employment opportunities, continued social engagement opportunities and age longevity are a major part and expectation of that strategy.

Additional research is necessary since senior education involves many variables and it is important that society understands these variations, because an understanding of the senior environment is critical to colleges and universities to assure higher education’s continued effectiveness and this cohorts continued and future third age success. This article sets the stage for that additional research.

### **Key Words & Definitions**

Cognitive Well-Being: Defined as a state of being comfortable, healthy, or happy; a good or satisfactory condition of existence; a state characterized by health, happiness, and prosperity.

Poor Cognitive Function: Low levels of education associated with less subject mastery, efficacy and happiness.

Happiness: Psychologists have defined happiness as a combination of life satisfaction and the relative frequency of positive and negative effects. Also defined as well-being.

Cognitive Well-being Measurements: Methods used to test or quantify general life satisfaction, generally measured using a self-report method. A common measurement for life satisfaction is the use of questionnaires.

Successful Aging: Includes three main components: low probability of disease and disease-related disability, high cognitive functional capacity, and active engagement with life.

Option 2 Careers: New career paths that are predicated on higher education either continued or begun near or at retirement.

Higher Education: Defined as 16 years of education or higher or undergraduate degree and above.

Third Age: Typically referred to as the prime years of life, i.e. ages 55 to 79, during which people are actively choosing how they will spend the last stage of their lives.

## **Significant Findings**

- Research indicates there is linkage between senior level higher education, career level employment, social engagement, well-being and the longevity of life. One of the primary drivers of longevity is being socially engaged, which is driven by involvement in higher education, which enhances employment opportunities, which ultimately assures a longer, happier life.
- Lifestyle practices such as education and intellectual engagement are associated with successful maintenance of cognitive abilities. Research findings support the positive effects of cognitive activity and the associated social engagement elements.
- Active or life-long education increases the cognitive health of the age 60+ seniors. Research shows that elders who demonstrate a higher level of cognitive health, via high ability, live longer than less educated elders.
- “Human flourishing, or well-being, flows from the development of one's capabilities, rather than from the simple fulfilment of basic needs.” Aristotle (330 b.c.)

## Statement of Purpose

The reason the topic of education, cognitive ability and well-being is important is that current research shows that many older individuals currently represent evidence of the theory that if you keep mentally and physically active, you can live a longer, healthier and happier life.

People are actively choosing how they will spend the later stages of their lives and continuing higher education is a major part of that strategy. Retirees and seniors in that cohort are now typically referred to “rebounders, prime timers, or re-careerers”. This is important because this will be an older population with many variables and understanding these variations is now, and will continue to be, even more critical to the higher education industry’s continued effectiveness.

In this paper, I am particularly interested in isolating the specific impact of education on the research we now have on cognitive ability and well-being, hoping to better isolate a situation that seniors can control, which is investing time and energy in education. I also want to add to the research of post retirement elders, defined as the age 60+ higher education group, to further investigate the impact of education on this particular group’s well-being, happiness and longevity.

There has been considerable research showing that older Americans with higher levels of education have more cognitive ability and a higher degree of well-being than those that do not achieve a higher level of education. There has also been some limited research that says education has had no such positive impact.

Research has shown that enhancing the cognitive ability and general well-being of an older person has a positive correlation with being happier, and that being happier has a positive correlation with the longevity of life. Since education can be such an important life enhancement metric, we

need to add to the research to learn more about its positive impact on those individuals that did achieve a level of higher education and about any marginal differences in the metrics about older Americans that have not achieved some level of higher education.

Another primary issue of this paper will regard the subject of whether education merely slows down the cognitive aging and decline process, or actually increases cognitive abilities, even when education is obtained after age 60.

I will add to the previous research about the theory that by maintaining cognitive ability and functionality, older individuals will be in better position to continue working or volunteering within their community, or even begin second or option 2 careers. This in turn, improves their mental health and happiness, through social engagement, which considerable research has shown will also add to their life expectancy (James and Spiro, 2007).

## Introduction

“Education has a powerful effect on the functional level in old age” and the relationship between age and functionality can be very different between levels of education” (Kahn, 2004). According to Rowe and Kahn (1997), the “Structure of Successful Aging” is defined as having three components: minimizing risk of disease, maintaining physical and mental functions and continuing engagement with life. This reading will focus primarily on the latter two.

If it is generally accepted that past and future education will have a positive impact on cognitive abilities, which in turn will facilitate the opportunities to continue to work, which in turn will add value to life, higher education certainly complements the objective of adopting activities that support continued engagement in life. As such, it is logical that education will ultimately lead to enhanced overall well-being. Rowe and Kahn’s theory is visualized as:



The finding that education has a powerful effect on functional level in old age

was also highlighted in the MacArthur Study community data and it is also confirmed in data from a larger national study, Americans Changing Lives.

These surveys, which were taken between 1986 and 2002 showed that the relationship between age and absence of functional limitations is very different for people with three different levels of education—high (16 or more years of education); medium (12 to 15 years); and low (less than 12 years). (House, et al., 2004).

Research by House and Kaplan (2004), shows a lack of education has the least effect on basic functionality at age 30, but we do begin to see a leveling off of functional capabilities, regardless of different levels of education, by age 90. This shows us that higher levels of education, and even continuing higher levels of education after retirement, does have inherent limitations. It appears that education will help the elderly to a point, but eventually at later stages, education no longer maintains that impact.

A primary purpose of this research paper is to add to the research about the value of education during the later stages of life. It is a particularly important subject to many older Americans, especially “Boomers”, who would like to invest the time and expense necessary to continue their academic aspirations and accomplishments, but would also like a reasonable idea of what they should expect as it regards financial and later-stage “option 2” career rewards.

This research is particularly important because this will continue to be an older population with many variables and understanding these variations is critical to institutions of higher education and higher education’s continued effectiveness. Important questions and issues that were addressed include:

1. Does active or life-long education increase the cognitive health of the 60+ aged?

2. Do elders that demonstrate a higher level of cognitive health, via high ability, live longer than less educated elders?
3. Do older Americans that continue education after age 60, to support an “*option 2* career” demonstrate a higher level of cognitive ability and well-being, as well as experience a longer active life span than less educated elders?
4. Is there an additional risk of cognitive decline and less well-being for older Americans that have not invested in higher education?

## Literature Review

An important focus of this article regards researching the demographics and the impact of education on the cognitive abilities of people who *continue* serious education after age 60. This is important to older individuals who are close to or actually beginning retirement and are seeking a strategy to maintain their cognitive abilities so they can continue their functionality and productive options. Considerable research suggests that higher education will also increase their overall happiness and longevity, primarily because of the social engagement that results.

Before researchers can try to quantify the advantages of seniors investing the time and energy in higher education, they must first perform some research on the general pre-retirement education levels and if that, from an isolated perspective, does in fact positively impact seniors cognitive abilities and the resulting well-being.

According to Finke (2012), education and mind stimulation has no considerable impact on the active life expectancy of the aged. That author states that “The *rate of decline* in old age does not appear to be slowed by education, intelligence or typical cognitive activities”

Quadagno (2014), states that education and mind stimulation does have considerable impact on the overall cognitive well-being of the aged and increases the active life expectancy of the aged.” As will be seen, this literary review does express more of a research consensus aligning with the Quadagno theory.

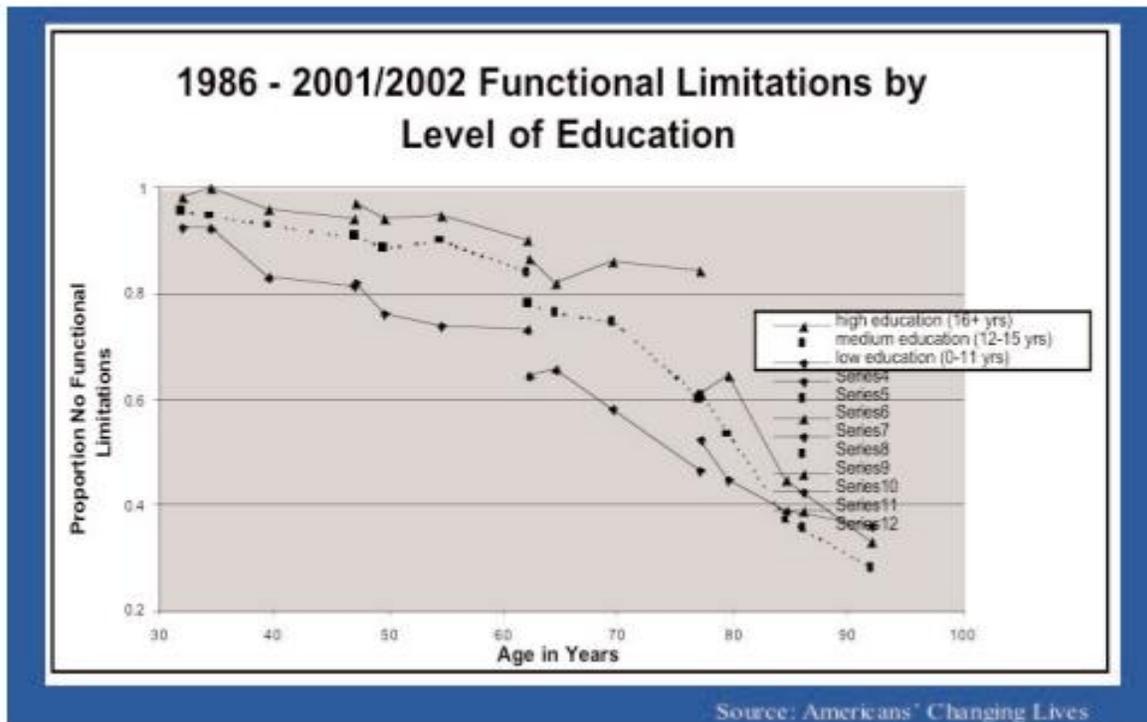
Leibovici et al. (1996), says “many studies have implicated low education as a risk factor for cognitive impairment in elderly people, but findings have been inconsistent”. Their study (Exhibit B) does suggest that the education level of young adults impacts or is greater on the cognitive change of older age groups.

The opinion that “education has a powerful effect on the functional level in old age” was expressed in research performed by Kahn (2004), in studies conducted between 1986 and 2002. The author also noted that the relationship between age and functionality can be very different between levels of education. As the following chart shows, Kahn (2004) believes it is therefore possible to generate a curve that shows the relationship between age and presence or absence of functional limitations.

Research by House (2004), showed that by age 40 people in the low education group begin to show significant declines and by age 60 those declines are sharp. For people with the most years of education, on the other hand, functional levels are quite stable until about age 80.

But by age 90, cognitive difference between educated and non-educated individuals were negligible, so at best, the increase in functional literacy has boundaries. The following graph shows the House theory (2004). Other conclusions expressed by Kahn (2004) include:

- The trend of the curves is downward; the proportion of people without functional limitations decreases with age.
- Educational level makes a big difference. People with the most education are quite free of functional limitations until age 75 and beyond; people with the least education experience the onset of functional limitations much earlier, at age 35, and precipitously after age 65.
- Even at age 65, however, most people report no functional limitations.



Research by Williams and Kemper (2010), identified lifestyle practices such as education and intellectual engagement, to be associated with successful maintenance of cognitive abilities and concluded that overall research findings support positive effects of cognitive activity and the associated social engagement elements, in optimizing cognitive aging.

The MacArthur Studies of Successful Aging also established the psychological benefits of education on cognition in aging individuals (Kubzansky et al., 1998). This study established that education exerts protective effects on both memory and crystallized intelligence while cognitive inactivity has been associated with reduced performance on fluid intelligence measures. It was also expressed that education is a stimulus to cognitive ability.

A clinic for the Advanced Cognitive Training for Independent and Vital Elderly (ACTIVE) addressed cognitive training effectiveness and also showed strong evidence that education is effective (Ball et al., 2002). During this study, two thousand randomly selected

adults were provided verbal episodic memory, inductive reasoning, and processing speed evaluations while compared to a control group.

A 5-year follow-up reported both better performance in memory, reasoning, or processing speed attributes and less functional decline in instrumental activities of daily living (IADLs) than the control group. During this study, the experimental group was also less likely to suffer significant declines in health related quality of life issues.

It should be noted that cognitive well-being impacts instrumental activities of daily living (IADLs) more than it does non-instrumental activities of daily living (ADLs). ADLs include activities to just get going, such as bathing and dressing, while IADLs are the things that people do once they are up and dressed and include activities such as managing finances or using a computer. It should also be noted that the brain, like all other organs, will certainly decline during old age, but education will very likely slow that decline.

Not many people are naive enough to believe that seniors will not slow down, both mentally and physically, but they take great comfort in believing that they will be valid participants in a constructive society and will only stop moving forward in life when it is physically and or mentally impossible, with a very high bar for possibility.

What is the relationship between work and mental health? James and Spiro (2007) concluded, as a following chart implies, that working people are less depressed than others in the survey, which many would believe creates a reciprocal value of being more mentally healthy and as a result, happier.

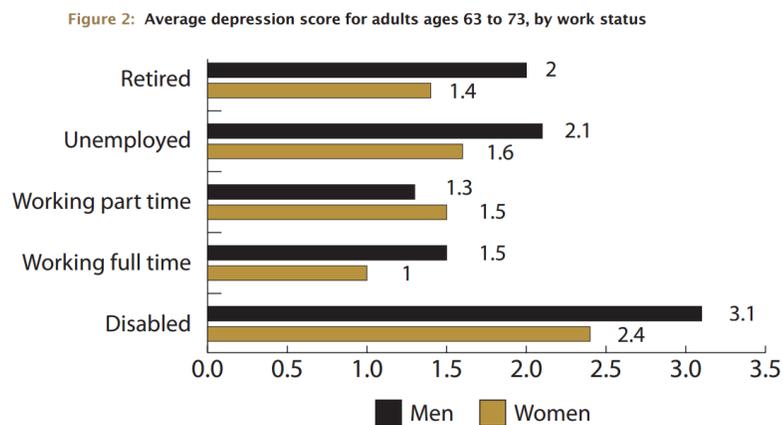
If research shows that education equals an increased cognitive ability and that the more cognitive ability elders have, the more likely they are to be socially engaged, either via

compensated or non-compensated working, then the data also supports the theory that working elders are most likely the happiest elders.

According to the “Attitudes of Individuals 50 and Older Toward Phased Retirement” survey conducted by the AARP (2005), the desire to stay mentally active (72% of Seniors) and the desire to remain productive and useful (71% of Seniors) were the issues most frequently identified by workers 60+ as major reasons for working in retirement.

Using the Health and Retirement Study Data, James and Spiro (2007), found that among men ages 63 to 73, the disabled had average depression levels of 2.4, compared to 1.4 for the retired, 1.5 for those working part-time, and 1.0 for those working full time.

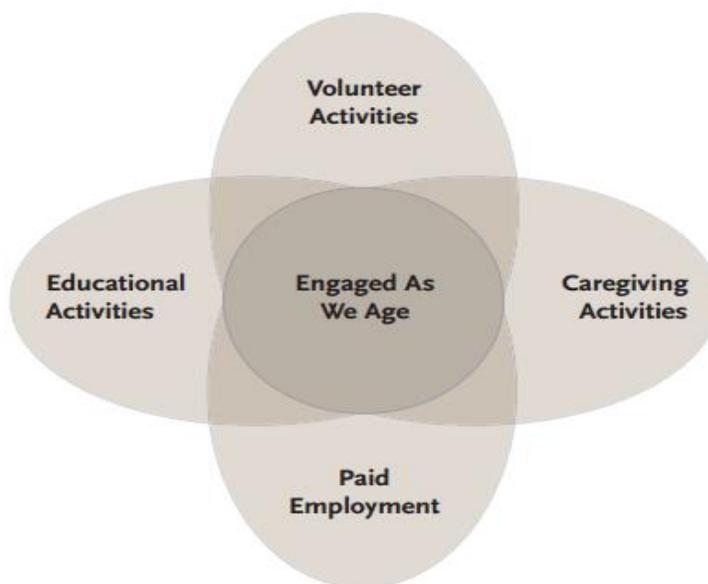
Using the Health and Retirement Study Data, James and Spiro (2007), also found that among women ages 63 to 73, the disabled had average depression levels of 3.1, compared to 2.0 for the retired, 1.6 for those working part-time, and 1.5 for those working full time.



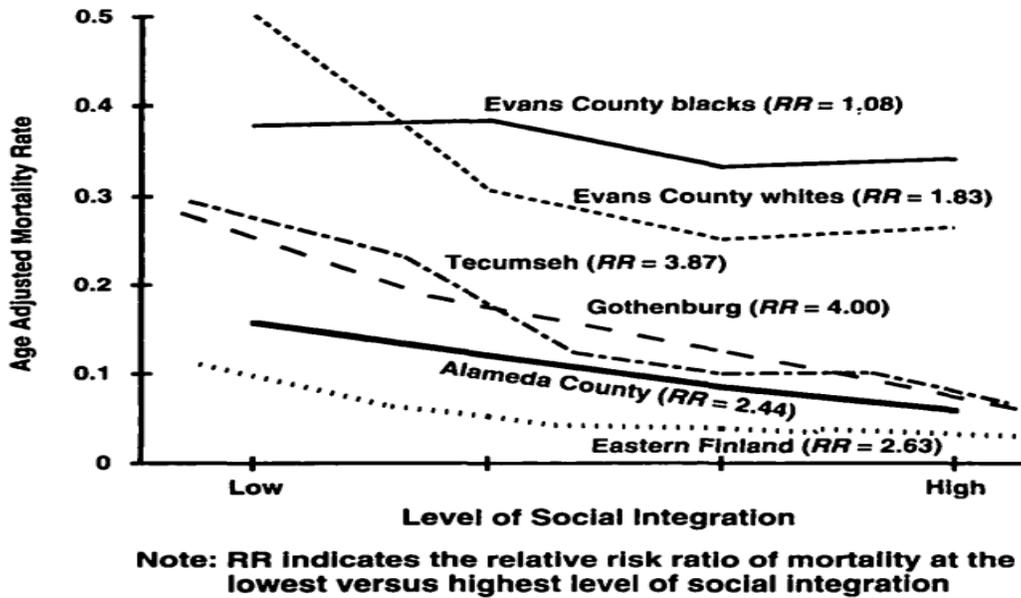
Again, according to James and Spiro (2007), this is important research because if it is true that taking care of one's mind via appropriate stimulation does in fact impact your functional age, then it is important to society as a whole to understand and practice that theory.

The article by Jacqueline et al., (2010) introduces the concept that because of research labeling aging as "healthy and productive" and suggesting a "best way" to age well, may imply that seniors suffering from debilitating disease are "unsuccessful". The authors suggest some revised modeling to better address that issue.

The "Engage as we Age" authors (Jacqueline et al., 2010), also state and express a model, built on the three aging frameworks, that "focuses on engagement with four specific activities including work, volunteering, caregiving, and education or lifelong learning". "They view education, in the form of lifelong learning, as the key to engagement in these activities" and that "continued learning and education also serve to better *both* the individual and his/her social world".



Jacqueline et al., (2010) also conclude engagement is a very important element of happiness in old age and that education is a key and primary facilitator of engagement. They also state that employment opportunities are linked to the idea of continuing paid employment during retirement, which has been quantified as contributing to longer life (Rowe and Kahn 1997). As such, and as per the authors model that follows, a logical conclusion would be that education does in fact lead to enhanced cognitive ability, overall well-being and life longevity.



“Educational level is a well-established predictor of sustained productive behavior, paid and unpaid” (Chambre, 1987; Cutler & Hendricks, 1990; Harris & Associates, 1981; Herzog, Franks, Markus, & Holmberg, 1996; Herzog & Morgan, 1993; Lawton, 1983; Morgan, 1986). “The possible mechanisms of this effect include the role of education as a major determinant of occupation and income, both of which are major influences on the life course” and overall well-being.

According to Vanhoutte & Nazroo (2014), “The hedonic view on well-being, consisting of cognitive and affective aspects, assumes that through maximizing pleasurable experiences, and minimizing suffering, the highest levels of well-being can be achieved”. The concept of a good life, well-being and happiness is that it’s not just about pleasure, but involves developing and realizing one’s potential, such as through higher education.

Even Aristotle (330 B.C.), emphasized that human flourishing, or well-being, flows from the development of one's capabilities, rather than from the simple fulfilment of basic needs.

The alternative to a course of higher education and engagement and happiness, according to Jacqueline (2010), is “Almost half of retired persons in a recent survey reported that they do not participate in volunteer or paid work and that 70% of these people report that watching TV is their primary retirement activity”.

According to Rubin (2007), “All of us are now in uncharted territory, a stage of life not seen before in human history. Whether woman or man, whether working-class or professional, we are all wondering how we'll live, what we'll do, who we'll be for the next twenty or thirty years”.

Most of the theories being expressed indicate we need to strive towards a plan for successful aging which includes maintaining a high degree of cognitive functionality and maintaining the highest level engagement with life as possible. Continuing higher education is a key element of that strategy.

According to Kim and Merriam (2004), demographics are the most consistent predictors of older adult's participation in higher education. Much of the qualitative research focuses on older adults who are female, white, highly educated, and middle class. Five demographic factors—age, race/ethnicity, gender, income level, and geography—reveal the complex makeup of this population.

Age is the greatest influencing factor, especially those born between 1945 and 1951 (Boomers), and includes individuals who are white/non-Hispanic, highly educated, females with 16 years of education, who were earning an average of \$45,000 per year. They also typically

lived in the northeastern part of the United States. On average, about 52% of those that invest in higher education after age 60 will either continue to work or start a second career.

Also according to Kim and Merriam (2004), the typical retiree that did not seek to participate in higher education were males with low levels of education, low incomes and with few resources, who lived in the south. Older adults with limited educational experience will choose formal learning less often than those with more higher education experience,

The American Council on Education and the MetLife Foundation (2007), states that in addition to demographic data, what motivates seniors to participate in higher education is: intellectual stimulation, (about 80%) social engagement (about 70%) and job skills enhancement (about 52 %). Older adults want to receive additional education that quickly puts them on the path to a new career and 66% plan to work during traditional retirement years.

As such and considering some differing opinions about the theory, I want to add to the current research and try to reject the null hypothesis:

Null Hypothesis: Educational investments made during early life, during pre-retirement periods and after retirement begins, do not add to the cognitive ability, well-being and life longevity of older Americans.

## Methods

Americans Changing Lives (ACL) was a study conducted by House et al., (2005), and includes data appropriate for such comparisons. The population sample for the ACL study, first interviewed in 1986, included 3,617 adults aged 25 years or more and were a nationally representative cross-section, selected by standard methods of probability sampling. Respondents in this study were interviewed again in 1989, 1994, and 2001/2002.

To test how education and training, after the beginning of retirement improves cognitive ability, Ball et al., (2004), evaluated whether cognitive training interventions improve mental abilities and daily functioning in older adults, a randomized, controlled, single-blind trial was conducted from March 1998 to October 1999 with 2-year follow-up through December 2001.

The sample included 2,832 persons aged 65 to 94 years for ten classes, recruited from 6 metropolitan areas in the United States. The results showed that 87% of speed, 74% of reasoning, and 26% of memory-trained participants demonstrated reliable cognitive improvement immediately after the intervention period. The study supported the effectiveness of education and training to improve cognitive abilities of the test group. The models and charts are shown in Exhibit A.

The Leibovici et al., (1996) study examined changes over a 1-year period with 283 elderly people with a mean age of 74 years and a gender split of 87 and 196 men and women respectively. The participants had showed recent sub clinical deterioration in cognitive functioning.

Results again showed that secondary memory and language functions were more resistant to decline in the higher-education group. It also concluded that education may have a more

important impact on changes in the memory and language functioning. Eight summary scores representing six cognitive domains were used in the analysis. Exhibits B-1 and B-2 provide the financial models used in this study.

Analysis was performed to review and investigate the association of education attainment with a number of risk factors among high-functioning elders (Kubzansky et al., 1998). Findings are from the MacArthur Studies of Successful Aging and used a cross-sectional analysis of psychosocial, behavioral, biological and educational attainment factors. Participants consisted of 1192 70- to 79-year-olds participating in a three-site longitudinal study performed during in-home interviews.

The data and methods used to quantify the theory that individuals with higher levels of education lived longer and happier lives than those that did not have any higher education, was performed by Vanhoutte & Nazroo (2014). Their analysis was based on the Longitudinal Study of Aging. It used a self-completion questionnaire (n=7398) with General Health, Depression and Satisfaction with Life, as the well-being measures. The gender split was 3312 men and 4086 women.

The authors Vanhoutte & Nazroo (2014), state that “one important aspect of our study to keep in mind in this regard is that we are not talking about chronological age, but about life phases”. This complex modeling process and analysis concluded that well-being emerges from the satisfaction of universal human psychological needs, such as self-actualization, control over their own lives and enjoyment, which aligned with most theories regarding the attributes of education and social engagement. Exhibit C contains the specific order structure and associated statistics.

## Findings

- Life-long higher levels of education, and even continuing higher levels of education after retirement, does have inherent limitations. It appears that education will help the elderly to a point, but eventually, at later stages, education levels no longer maintain that impact. (House and Kaplan, 2004).
- The brain, like all other organs, will certainly decline during old age, but education will likely slow that decline (Ball et al., 2002).
- “Many studies have implicated low education as a risk factor for cognitive impairment in elderly people, but findings have been inconsistent” (Leibovici et al., 1996).
- The relationship between age and functionality can be very different between levels of education (Kahn, 2004).
- Education exerts protective effects on both memory and crystallized intelligence while “cognitive inactivity has been associated with reduced performance on fluid intelligence measures”. Education is a stimulus to cognitive ability (Kubzansky et al., 1998).
- Working people are less depressed than others in the survey, which many would believe creates a reciprocal value of being more mentally healthy and as a result, happier (James and Spiro, 2007).
- Continuing paid employment during retirement has been quantified as contributing to longer life (Rowe and Kahn, 1997).
- The concept of a good life, well-being and happiness is not just about pleasure, but involves developing and realizing one's potential, such as through higher education (Vanhoutte and Nazroo, 2014).

- Demographics are the most consistent predictors of older adult's participation in higher education (Kim and Merriam, 2004).
- Well-being emerges from the satisfaction of universal human psychological needs, such as self-actualization, control over their own lives and enjoyment, which aligned with most theories regarding the attributes of education and social engagement (Vanhoutte and Nazroo, 2014).

## Conclusions

Higher education prior to and especially post age 60 certainly appears to add to the cognitive ability and functionality in older Americans. Research has shown that seniors with lifelong higher education have lower mortality rates and a higher rate of social integration than those who do not. Research has also shown that the majority of older Americans who invest in higher education after age 60 re-enter the compensated career level workforce and as a result of the continuing social integration are happier and enjoy enhanced longevity.

Since social integration is cited numerous times as being a driving factor behind a happier, longer life then it is also valid to hypothesize that higher education at retirement ages is a primary facilitator of that marginal, continued social integration. Further research is certainly warranted here using a longitudinal research method and data from traditional, tuition based college and university relationships.

The premise that education received prior to age 60 does not add to cognitive ability and functionality, but it may help maintain current levels of cognitive ability and functionality longer, may have some validity, but mental atrophy resulting from an unstimulated cognitive state is to be expected. Again, more research is needed here to explore ideas reflecting the cause and effect of time gaps between various life-long educational levels or benchmarks.

Thus, the stage is set for intervention studies to further identify effective strategies that support the proportion of our older population that enhance their cognitive ability, continue to integrate with society and ages successfully, especially through higher education efforts.

As a result of this research, I reject the null hypothesis that educational investments made during early life, during pre-retirement periods and after retirement begins do not add to the cognitive ability, well-being and longevity of older Americans.

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## **Exhibits**

### **Exhibit A**

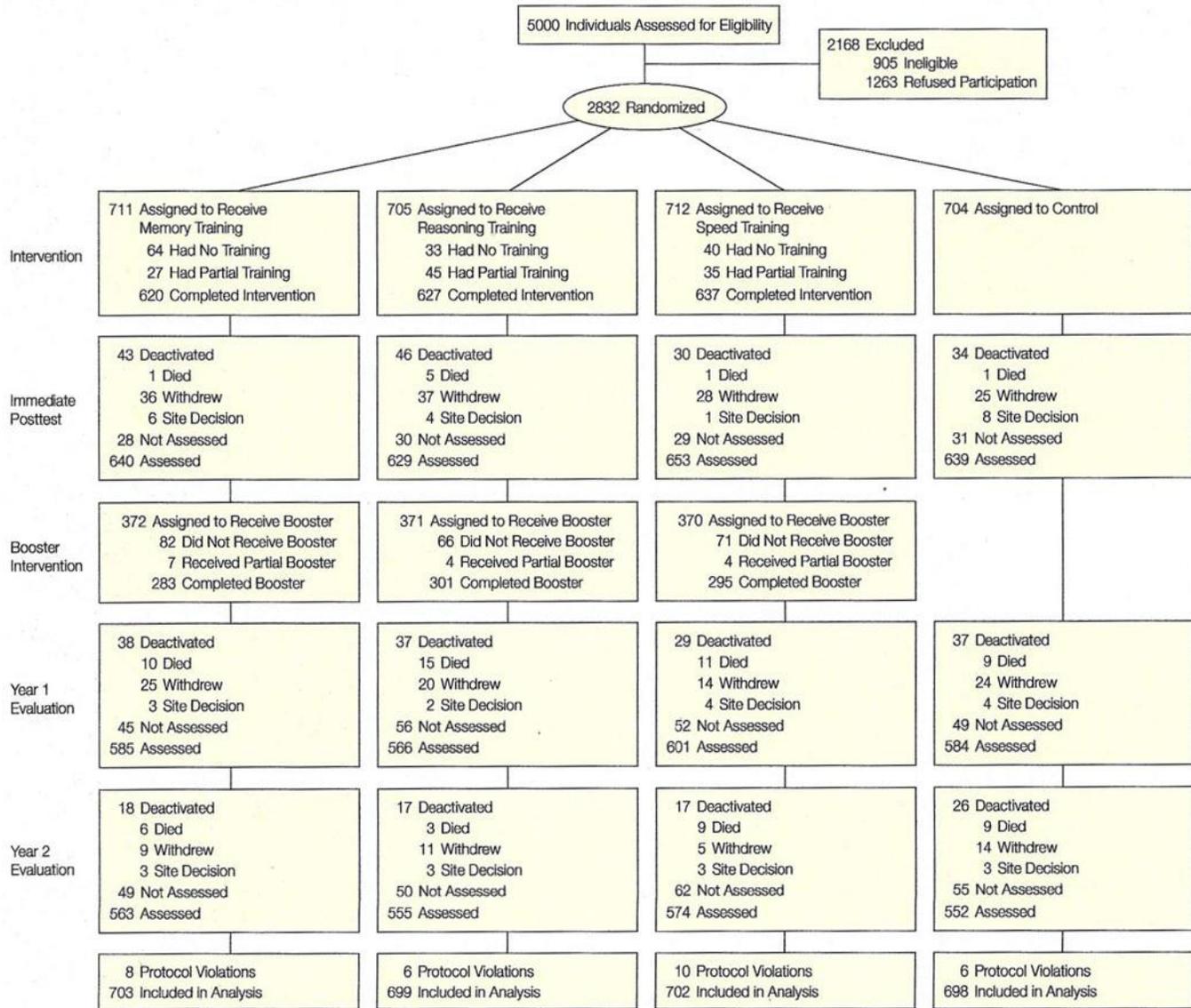


Exhibit B-1.

*Table I.* Mean rank scores and Kruskal–Wallis tests for each cognitive function assessed, for two age ranges and two levels of education

| Education group | 4         | 3         | 2         | 1         | K-W(p)         |
|-----------------|-----------|-----------|-----------|-----------|----------------|
| <b>W1</b>       |           |           |           |           |                |
| Attention       | OL<br>119 | OH<br>137 | YH<br>151 | YL<br>154 | 8.09<br>(0.04) |
| Language        | OL<br>126 | OH<br>134 | YL<br>138 | YH<br>162 | 8.4<br>(0.03)  |
| RT              | OL<br>92  | OH<br>147 | YL<br>148 | YH<br>169 | 32.6<br>(0)    |
| RC              | OL<br>106 | OH<br>136 | YL<br>144 | YH<br>171 | 23.2<br>(0)    |
| Memory          | OL<br>108 | OH<br>140 | YL<br>150 | YH<br>162 | 16.8<br>(0)    |
| primary         |           |           |           |           | 3              |
| secondary       |           |           |           |           | NS             |
| implicit        |           |           |           |           |                |
| Visuospatial    | OL<br>97  | OH<br>130 | YL<br>149 | YH<br>178 | 34.1<br>(0)    |
| RT              | OL<br>109 | OH<br>138 | YL<br>141 | YH<br>172 | 25.1<br>(0)    |
| RC              |           |           |           |           |                |
| <b>W2</b>       |           |           |           |           |                |
| Attention       | OL<br>112 | OH<br>128 | YL<br>158 | YH<br>160 | 17.9<br>(0)    |
| Language        | OL<br>101 | YL<br>139 | OH<br>148 | YH<br>169 | 22.6<br>(0)    |
| RT              | OL<br>103 | OH<br>143 | YL<br>155 | YH<br>158 | 19.8<br>(0)    |
| RC              | OL<br>102 | OH<br>146 | YL<br>148 | YH<br>162 | 20.6<br>(0)    |
| Memory          | OL<br>101 | OH<br>134 | YL<br>152 | YH<br>168 | 26<br>(0)      |
| primary         |           |           |           |           | 5.5            |
| secondary       |           |           |           |           | NS             |
| implicit        |           |           |           |           |                |
| Visuospatial    | OL<br>95  | OH<br>138 | YL<br>159 | YH<br>165 | 31.7<br>(0)    |
| RT              | OL<br>105 | OH<br>134 | YL<br>143 | YH<br>174 | 26.3<br>(0)    |
| RC              |           |           |           |           |                |
| Education group | 1         | 2         | 3         | 4         | K-W(p)         |

## EDUCATION LEVEL AND THE COURSE OF COGNITIVE DECLINE

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Table II. Mean scaled scores (and standard deviations) by age group and education for each cognitive function

| Cognitive function | Wilcoxon-Z    |               |                |               |                |               | Kruskal-Wallis |             |
|--------------------|---------------|---------------|----------------|---------------|----------------|---------------|----------------|-------------|
|                    | 60-69 years   |               | 70-79 years    |               | ≥ 80 years     |               | Low            | High        |
|                    | Low (n = 33)  | High (n = 44) | Low (n = 63)   | High (n = 64) | Low (n = 40)   | High (n = 39) |                |             |
| <b>W1</b>          |               |               |                |               |                |               |                |             |
| Attention          | 85 (13)<br>NS | 84 (12)       | 82 (15)<br>NS  | 84 (14)       | 74 (20)<br>NS  | 77 (18)       | 8.1 (0.02)     | 3.1 (0.2)   |
| Language           | 69 (17)<br>NS | 72 (17)       | 69 (17)<br>NS  | 73 (15)       | 64 (19)<br>NS  | 64 (20)       | 1.4 (0.5)      | 5 (0.07)    |
| RT                 |               |               |                |               |                |               |                |             |
| RC                 | 72 (14)<br>NS | 76 (12)       | 67 (17)<br>••  | 74 (11)       | 60 (17)<br>••• | 70 (16)       | 13 (0.001)     | 1.8 (0.4)   |
| Memory             | 59 (18)<br>NS | 62 (17)       | 51 (16)<br>••• | 62 (17)       | 51 (16)<br>NS  | 53 (16)       | 8.2 (0.02)     | 9.4 (0.01)  |
| primary            |               |               |                |               |                |               |                |             |
| secondary          | 62 (18)<br>NS | 64 (19)       | 55 (19)<br>••• | 66 (17)       | 55 (20)<br>NS  | 62 (20)       | 2.7 (0.3)      | 0.9 (0.6)   |
| implicit           | 45 (11)<br>NS | 44 (13)       | 46 (15)<br>NS  | 46 (13)       | 49 (18)<br>NS  | 46 (17)       | 0.6 (0.7)      | 0.08 (0.95) |
| Visuospatial       | 71 (18)<br>NS | 76 (14)       | 67 (14)<br>•   | 72 (14)       | 54 (20)<br>•   | 63 (20)       | 17 (0.0002)    | 8.9 (0.01)  |
| RT                 |               |               |                |               |                |               |                |             |
| RC                 | 76 (21)<br>NS | 83 (11)       | 69 (21)<br>•   | 77 (14)       | 63 (24)<br>•   | 75 (17)       | 8.6 (0.01)     | 5.4 (0.07)  |
| <b>W2</b>          |               |               |                |               |                |               |                |             |
| Attention          | 82 (19)<br>NS | 81 (16)       | 76 (18)<br>•   | 84 (13)       | 64 (29)<br>NS  | 70 (21)       | 11 (0.005)     | 11 (0.003)  |
| Language           | 66 (20)<br>•  | 75 (13)       | 64 (17)<br>••• | 73 (12)       | 58 (23)<br>NS  | 65 (20)       | 2.5 (0.3)      | 6.9 (0.03)  |
| RT                 |               |               |                |               |                |               |                |             |
| RC                 | 73 (19)<br>NS | 75 (13)       | 68 (17)<br>NS  | 71 (13)       | 58 (23)<br>••  | 70 (18)       | 11 (0.005)     | 2.25 (0.3)  |
| Memory             | 63 (21)<br>NS | 69 (18)       | 57 (18)<br>NS  | 62 (18)       | 53 (19)<br>•   | 62 (18)       | 5.4 (0.07)     | 3.4 (0.2)   |
| primary            |               |               |                |               |                |               |                |             |
| secondary          | 65 (18)<br>NS | 68 (16)       | 59 (16)<br>•   | 64 (17)       | 51 (20)<br>NS  | 58 (18)       | 10 (0.007)     | 6.7 (0.03)  |
| implicit           | 51 (14)<br>NS | 46 (16)       | 51 (17)<br>NS  | 49 (14)       | 51 (20)<br>NS  | 46 (17)       | 0.25 (0.9)     | 2.2 (0.3)   |
| Visuospatial       | 75 (11)<br>NS | 73 (13)       | 70 (15)<br>•   | 75 (11)       | 59 (18)<br>••  | 68 (15)       | 18 (0.0001)    | 5.5 (0.06)  |
| RT                 |               |               |                |               |                |               |                |             |
| RC                 | 76 (19)<br>NS | 82 (11)       | 75 (15)<br>••  | 80 (12)       | 66 (17)<br>NS  | 72 (15)       | 9.6 (0.008)    | 11 (0.004)  |

NS = not significant; • &lt; 0.05; •• &lt; 0.01; ••• &lt; 0.001.

Exhibit C:

**Table 1.** Overview of the second order structure of subjective well-being

| Model 1                | Model 2               | Model 3              | Model 4              | Model 5                      |
|------------------------|-----------------------|----------------------|----------------------|------------------------------|
| GHQ Anxiety            | Subjective Well-being | Hedonic Well-being   | Affective Well-being | Hedonic Affective Well-being |
| GHQ Social dysfunction |                       |                      |                      |                              |
| GHQ Loss of confidence |                       |                      |                      |                              |
| CES-D Somatic          |                       |                      |                      |                              |
| CES-D Mood             |                       |                      |                      |                              |
| SWLS Present           |                       | Eudemonic Well-being | Cognitive Well-being | Hedonic Cognitive Well-being |
| SWLS Past              |                       |                      |                      |                              |
| CASP Control &Autonomy |                       |                      |                      | Eudemonic Well-being         |
| CASP Self-Realisation  |                       |                      |                      |                              |
| CASP Pleasure          |                       |                      |                      |                              |

**Table 2.** Fit statistics for second order models (N=7398)

|         | Chi square | Df  | RMSEA | CFI   |
|---------|------------|-----|-------|-------|
| Model 1 | 12483.60   | 693 | 0.048 | 0.914 |
| Model 2 | 19681.66   | 728 | 0.059 | 0.862 |
| Model 3 | 18466.86   | 727 | 0.057 | 0.871 |
| Model 4 | 15832.49   | 727 | 0.053 | 0.890 |
| Model 5 | 14137.15   | 725 | 0.050 | 0.903 |