

## **ABSTRACT**

WHITLOCK, LAURA ANNE. An Online Social Video Game as a Cognitive Training Tool for Older Adults. (Under the direction of Anne Collins McLaughlin.)

Age-related cognitive decline begins in early adulthood, and older adults tend to show reduced performance on a number of types of cognitive abilities. Thirty-nine older adult took part in a study to determine the effectiveness of an online social video game as a cognitive training tool as either experimental (n=19) or control (n=20) participants. Experimental participants attended a training session and then played the game at home for about 14 hours over a two-week period. Hierarchical regression analysis revealed that experimental participants improved significantly more than control participants on a measure of attentional control between pre- and post-test. Results and future directions are discussed.

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An Online Social Video Game as a Cognitive Training Tool for Older Adults

by  
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## **BIOGRAPHY**

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## INTRODUCTION

### **Cognitive Change Over the Lifespan**

Age-related cognitive decline is a well-established phenomenon that begins in early adulthood (Salthouse, 2004). The decline may accelerate with age, with older adults exhibiting significant deficits in many areas of cognitive performance, specifically the areas of fluid intelligence (Horn & Cattell, 1967; Salthouse 2004). Fluid intelligence comprises a number of abilities that allow abstract thinking, reasoning, solving new problems and learning new information. Declines in these areas account for most of the age-related differences found in performance (Pak, Czaja, Sharit, Rogers & Fisk, 2008). However, it may be possible to slow or even reverse these age-related declines in fluid ability via cognitive training in those abilities (Basak et al., 2008; Bugos et al., 2007; Noice, Noice & Staines, 2004). Effective cognitive training interventions have the potential to impact many different types of abilities and could result in improved quality of life and longer independence for older adults.

Abilities such as working memory, perceptual speed, and executive function are examples of the abilities that make up fluid intelligence. Working memory is a major component of fluid intelligence and is the process by which information is temporarily stored and manipulated (Baddeley, 1992). It is, however, distinct from short term memory in that working memory also appears to represent the ability to control attention (Engle, 2002). Working memory capacity decreases with age (Wingfield et al., 1988).

Perceptual speed is the ability to quickly and accurately examine visual stimuli for the purposes of a specific goal, such as conducting a visual search or making comparisons



between symbols. Driving a car is an example of a real-world task that relies on perceptual speed. Perceptual speed declines with age (Verhaeghen & Salthouse, 1997)

Executive function is defined as the processes in which goal-directed behaviors have to be flexibly maintained, monitored, and implemented in the face of changing memory loads, distractions, task sets, and other possibilities (Basak et al., 2008). Like working memory, it relates to the ability to control attention (Engle, 2002). For example, attempting to complete a task while ignoring a distracting conversation would rely on executive function. Executive function declines with age (Cepeda, Kramer & Gonzalez de Sather, 2001; Vergaeghen & Cerella, 2002) independently of underlying abilities such as working memory and speed (Cepeda, Kramer & Gonzalez de Sather, 2001). This suggests that age-related decrease in executive function is a separate and distinct phenomenon from the age-related decrease of working memory and speed, which highlights the importance of testing multiple cognitive abilities when examining the cognitive abilities of a population.

Mental rotation, a type of spatial ability, is the ability to rotate two- or three-dimensional figures both quickly and accurately (Linn & Petersen, 1985). Map-reading, for example, requires the reader to mentally rotate the map display to align it with his or her current location. Mental rotation speed and accuracy decline with age (Driscoll et al., 2005).

The decline of these abilities with advancing age is a phenomenon of real-world importance. These types of fluid abilities have direct effects on performance on many everyday tasks important to older adults, such as driving. Older adults who maintain higher levels of these abilities should be able to perform more activities, perform them more safely, and ultimately retain more independence in their daily lives than older adults whose fluid

abilities decline heavily with age.

### **Cognitive Training**

Given the widespread nature of cognitive decline in older adulthood it is unsurprising that there have been many attempts to slow or reverse this decline. The outcomes of these training studies have been mixed. While training has sometimes been demonstrated to improve older adult performance on tests of fluid abilities, this improvement could in some cases be the result of strategy learning rather than an improvement of the underlying cognitive abilities. In one study that demonstrated the positive effect of training on reasoning ability in older adults (Denney & Heidrich, 1990), training participants completed only six reasoning problems while being coached on the strategies used to solve them. Although participants did then show improvement on those types of reasoning problems, the low number of training problems and the emphasis on strategy suggests that their improvement was due to strategy adoption rather than improvement of underlying reasoning ability.

The largest study of cognitive training for older adults, the ACTIVE trial, examined the effects of memory, reasoning, and speed of processing training in older adults (Ball et al., 2002). While participants in each of the three training groups showed significant performance gains in tests of the ability in which they were trained, there was no transfer of training between groups, nor did any of the groups exhibit improved performance on tests of everyday problem solving or on activities of daily living. Furthermore, the memory training and reasoning training were composed in part of strategy teaching. Participants in the memory training condition were taught mnemonic strategies for remembering word lists and

other text material, and participants in the reasoning training condition were taught strategies for identifying serial patterns. This suggests that some of the improvement shown by the memory and reasoning training groups was the result of strategy use, which may help explain the lack of transfer exhibited in the study.

Other less conventional training approaches have had more encouraging results. Unconventional cognitive training approaches are more integrative than conventional approaches, and typically involve engaging in cognitively complex activities rather than repeated practice of tests that target a single ability. Theater and visual arts programs are two unconventional training programs that have been examined in research. Older adults who underwent a month-long theater training or visual arts instruction program showed significant improvement over a control group on word recall and problem solving, and the theater training group significantly outperformed the visual arts group on problem solving (Noice, Noice & Staines, 2004). In another study, older adults who received individualized piano instruction improved significantly more than a control group on measures of executive function and perceptual speed (Bugos et al., 2007).

In both of these unconventional approaches to training, participants were never explicitly trained on the abilities in which they were tested. All exercises and scenes in the theater intervention (Noice, Noice & Staines, 2004) were short and participants held a written copy of the script while performing; the theater training therefore did not require any actual memorization, nor were participants taught problem solving strategies like they were in the ACTIVE study (Ball et al., 2002). Similarly, in the individualized piano instruction intervention (Bugos et al., 2007) the musical training consisted of standard lessons on music

theory and note reading as well as playing actual pieces on the piano, and not of lessons on task switching or exercises designed to improve perceptual speed.

There is some debate as to what populations of older adults can most benefit from cognitive interventions. Because neural plasticity declines with age, one school of thought suggests that the younger old can benefit more than the older old (Nyberg, 2005). These younger and consequently higher-functioning individuals have more capacity to rewire their brains in response to cognitive interventions. However, another school of thought suggests that older and lower-functioning individuals might have more capacity to benefit from cognitive interventions benefit from cognitive interventions ((Salthouse, Berish & Miles, 2002), a view which is supported by correlational data on older adults and self-reported activities (Hultsch, Hammer, & Small, 1993).

Regardless of what individual characteristics best predict improvement from cognitive interventions, effortful attentional control of multiple abilities seems to be critical for successful cognitive training. In the theater and piano instruction studies, the benefits seen in these studies were the result of performing complex activities that rely heavily upon multiple fluid abilities under demanding attentional control. Attentional control was demanding and difficult, as participants in these studies switched frequently between multiple abilities.

One difficulty inherent in this type of high-effort relates to the degree of challenge involved. To produce maximal effort the task must be challenging to the participants, and the task should be one that stays challenging throughout the intervention. This is likely to lead to low performance on the intervention task, which may lead some to wonder whether the

degree of change in the brain related to success in the training task. One study has shown that young adults' brains exhibit changes in white matter in response to training in how to juggle (Scholz, Klein, Behrens & Johansen-Berg, 2009). While there was significant variability in level of skill at the end of the training, all participants showed changes in white matter, regardless of skill level attained. This suggests that the physical changes in the brain as the result of training are not influenced by the degree of skill attained so much as by the time and effort devoted to the training.

### **Social Interaction**

Social interaction may represent an important moderator in the effect of training on cognitive ability. Two successful interventions, the individualized piano instruction training (Bugos et al., 2007) and theater and arts intervention (Noice, Noice & Staines, 2004), included a social element. Individualized piano instruction included weekly lessons with an instructor, while the theater training and visual arts training required older adults to interact in groups with the assistance of an instructor. All three training tasks were highly social activities where the participants were able to either interact one-on-one or with a group of their peers. It may be that this social interaction encouraged maximal devotion of attention and effort.

Research does suggest that social engagement may be an important factor in maintaining cognitive ability in older adulthood. In one study, 354 adults aged 50 and older were tested with the Mini-Mental State Examination, a 10-minute test designed to screen for cognitive impairment, and then re-tested over a decade later. Interaction in larger social

networks was related to better maintenance of Mini-Mental State Examination scores (Holtzman et al., 2004). Another study of adults over 65 found that poor social connections and infrequent participation in social activities were predictors of cognitive decline, independent of factors such as depressive symptoms and functional status (Zunzunegui et al., 2003).

While a relationship between social engagement and maintenance of cognitive ability in older adulthood does appear to exist, the studies detailed above are correlational findings, so it would be premature to state that increasing older adults' social engagement would have a protective effect on their cognitive abilities. However, social interaction may play another important role in cognitive training. Most people find social interaction to be pleasurable and to enhance their enjoyment of many activities. A social component to a cognitive training program could therefore increase participant commitment to the program and the level of attentional involvement and effort.

Of the unconventional cognitive interventions, the improvisational theater program (Noice, Noice & Staines, 2004) is arguably the most intensely social. Participants had to interact with others not only as themselves but as the characters they portrayed, and through their characters participants experienced a wide range of emotionally-charged interaction with others. The authors note that a supportive group dynamic emerged between the participants over the course of the study. This kind of social dynamic may be an important contributor to a training program's success.

## **Games as Tools for Cognitive Training**

Because of the success of unconventional approaches to cognitive training there is growing interest in the use of video games for training cognitive abilities. Video and computer games can be complex and flexible activities that load on multiple fluid abilities, can be designed to offer motivational rewards, and can be played socially. They have been shown to improve younger adults' cognitive abilities such as spatial attention (Feng, Spence & Pratt, 2007; Green & Bavelier, 2003; Green & Bavelier, 2006) and mental rotation ability (De Lisi & Cammarano, 1996; Feng, Spence & Pratt, 2007; Okagaki & Frensch, 1994; Terlecki, Newcombe & Little, 2008). These improvements in spatial ability has been shown to not only transfer to other spatial tests (Terlecki, Newcombe & Little, 2008) but also to remain undiminished at a five-month follow-up despite the discontinuation of video game training in the interim (Feng, Spence & Pratt, 2007). Video games have also been demonstrated to improve reasoning skills in young adults (Wood & Peneé, 1987) and used successfully in a cognitive rehabilitation program for children (Larose et al., 1989).

Given these successes with video games as tools for cognitive training in younger adults, the next step was to apply them for cognitive training with older adults. A recent study examined the use of a real-time strategy game called Rise of Nations in a cognitive training program for older adults (Basak et al., 2008). Rise of Nations, published by Microsoft Games, required the player to gather resources, research technologies, and build and control large armies all in real time. Participants in the experimental group played the game for 23.5 hours and showed significant improvements in task switching, working

memory, visual short-term memory and reasoning when compared to the control group (Basak et al., 2008).

### *Motivation*

One of the most important attributes of video games as a cognitive training tool is that they are specifically designed to be fun to play. Conventional cognitive training approaches involve practicing specific abilities, like mental rotation or working memory, and often consist of repetitive exercises that are not necessarily enjoyable to complete. While participants may be initially motivated to complete these exercises to improve their mental abilities, despite their best intentions they may become more likely to stop or devote less than their full attention due to the repetitive nature of the task. When the activity is fun, however, people may be drawn to it for its own sake. Furthermore, because games incorporate a system of visible rewards (e.g., scoring points, solving a puzzle and being allowed to progress to the next stage, a “You win!” screen), players are rewarded for their success and motivated to continue playing. The motivational effect of these rewards are not limited to games; adding extrinsic motivators like sound effects can dramatically reduce failure rates even in high performance tasks like air traffic control (Schneider, 1985).

Comparatively few studies have tested the effectiveness of using video games to improve cognitive abilities in older adults, perhaps because of the perception that older adults are reluctant to adopt new technology or that they may be unwilling to play video or computer games. However, older adults are in fact likely to use technology when they perceive there to be benefits to using it (Melenhorst, Rogers & Bouwhuis, 2006) and that the



technology has relevance to their lives (Selwyn et al., 2003).

Older adults also exhibit interest in a wide variety of games. In a 2000 study of older adults' interest in 48 different games, older adults expressed a high level of interest in games and also that they tend to prefer sedentary games to physically active games (Hoppes, Hally & Sewell, 2000). They were also particularly interested in games that can be played on varying levels of strategic complexity, such as dominoes (Hoppes, Hally & Sewell, 2000). Several elements have been identified as important to older adults' enjoyment of game playing, including mental fitness, competition and winning, filling their time in a way that provides satisfaction, and a sense of belonging in social games (Hoppes, Wilcox & Graham, 2001).

This suggests that once older adults perceive the advantages of video games and go through an initial learning period, video games may be suited for older adults. While video games can be physically active, many are sedentary and suitable for players with mobility issues. Their complexity and difficulty can be adjusted to match the player's level of skill, either through player selection of a difficulty level or even through the game dynamically adjusting itself to player performance. The recent success of video games marketed as “brain training” products highlights the public perception that video games can be used for mental fitness, even if current games are not proven to offer benefits. Video games can be individual, cooperative or competitive in nature, allowing the player to select the level of competition they prefer.

Games can also require a high degree of social involvement to play. Video and computer games are often highly social activities, both in-person and through distributed

means such as the internet. Nintendo Wii bowling leagues have become popular among older adults, with over 450 teams and 2500 players participating in the National Senior League for Wii Bowlers as of 2010 (National Senior League, 2010).

Social involvement appears to be important for enjoyment of and continued motivation while taking part in a cognitive intervention. In the theater intervention (Noice, Noice & Staines, 2004), the authors note that the highly supportive and social group dynamic that emerged among the theater participants may have played an important role in participant motivation. While eight of the 44 participants in the visual arts group dropped out during the course of the study, all participants in the theater group continued until the end.

In sum, cognitive training for older adults is an area of research with great potential. Video games in particular have the potential to be a cognitive training tool uniquely suited to older adults. Further research is needed to identify what types of games can lead to the most improvement in cognitive function for older adults, and also how best to customize the games for an older adult audience. One potentially useful tool for cognitive training was the popular video game World of Warcraft. This game was social and required the simultaneous use and allocation of multiple cognitive resources.

### **World of Warcraft**

World of Warcraft is a massively multiplayer online role playing game (MMORPG) created by Blizzard Entertainment. MMORPGs are a popular type of game in which a large number of players interact within a virtual world. World of Warcraft is currently one of the most popular MMORPGs, with 11.5 million players as of 2008. Each player had a character

in the game, represented by a three-dimensional avatar with a customizable physical appearance. Players can pick the gender, skin tone, hair color and style and facial appearance of their characters. Characters can move freely around the game world. The virtual world of the game is made up of villages, cities, forests, deserts, mountains, caves, rivers, oceans and other natural features. Portions of the world have their own weather systems, so that sand storms can occur in deserts and rain falls in some temperate regions.

Players can interact with the game world in a variety of ways. The world is inhabited by computer-controlled creatures, both friendly and hostile. For instance, a snowy region in the game may be populated with harmless rabbits, polar bears, and large, highly dangerous dragons. Players can engage in combat with these creatures and some creatures are so powerful that they require groups with as many as 40 players working together to defeat them.

Quests are another major feature of the game. Computer-controlled characters, known as non-player-characters (NPCs) offer quests to players. The goal of a quest may vary greatly from quest to quest. A player may be asked to defeat a computer-controlled creature, gather flowers that grow by a nearby alligator-infested lake, or to escort the NPC as it travels through a cave filled with hostile creatures.

Players who successfully complete these quests receive rewards such as in-game currency, better weapons or armor, and experience points. As players complete quests and acquire experience points their characters gain levels. With each level gained a character becomes more powerful and is better able to take on more difficult challenges. Players also gain additional skills and abilities that help them with the challenges in the game. They must

choose the ideal combination of these skills and abilities for each challenge, making the game more complex as players progress and maintaining a level of challenge appropriate to the skill of the player.

While players can play some parts of World of Warcraft by themselves, most people choose to play World of Warcraft with other people. Players join together in groups to help each other defeat creatures or complete quests. Players can take on specific roles in a group, such as acting as the group's healer and restoring health to other members of the group. Many quests can only be accomplished by groups of players, and players typically communicate through text or voice chat to coordinate with their groups.

### *Interface*

Both the keyboard and mouse are used for input. Players can move their characters with either the arrow keys (up, down, left and right) or the W, A, S and D keys, which are arranged in the same layout as the arrow keys. They can also assign other keys as “hotkeys” - keys that trigger frequently-performed actions within the game. Players can also perform actions within the game by using the mouse to click on icons on the screen.

There are also a number of on-screen display elements. Text communications from other players are displayed in a text box, as is text describing actions and events within the game. A small map is on-screen at all times and gives an overhead view of the player's location. A character's attributes, such as health, are also displayed on the screen at all times. The player must monitor these displays while simultaneously controlling a character with the keyboard and initiating commands with the mouse.

### *Cognitive Demands*

While World of Warcraft appeared to be a cognitive demanding game but a more formal analysis was needed to identify the types of cognitive abilities used during play. A cognitive task analysis (CTA) was conducted of both novice and expert performance in the game.

All potential participants were pre-screened with a questionnaire to assess their level of experience with World of Warcraft. They were blind to the type of participants we were recruiting. This was done to ensure unbiased recruitment. Four participants were then selected for the study based on their answers in the questionnaire. Two were classified as novices and two were classified experts. All participants received class credit for their participation.

Participants were then recorded individually as they played World of Warcraft. An experimenter with a video camera captured all of the activity on the screen as well as the participant's spoken comments. Participants were asked to speak all of their thoughts aloud as they progressed through the game. If necessary, the experimenter prompted them with statements like "Please tell me what you are doing now" and by asking questions such as "Why did you do that?" All participants played the same portion of the game for an hour.

The video recordings were then used to conduct a cognitive task analysis. A CTA is a set of methods for identifying the cognitive skills, or mental demands, needed to perform a task proficiently (Militello & Hutton, 1998). The CTAs were conducted using the recordings from one novice player and one expert player. The novice player chosen for the analysis was selected on the basis of her inexperience, because during the course of the session with the

other novice it became apparent that he had experience with other games of a similar nature to World of Warcraft. A brief overview of the recordings of the two experts showed them to be very similar. This was unsurprising given that we selected an early portion of the game for the task. Most experienced players have completed that portion of the game before, sometimes many times, and therefore know the most efficient way to proceed. One of the two experts was therefore selected for the CTA on the basis of having a more clear speaking voice.

The CTA identified a number of cognitive abilities required by the game during play by both a novice (Figure 1) and expert (Figure 2). Although the CTA suggests that novice and expert players proceed through the game in different ways, both had to engage in a number of demanding cognitive processes to accomplish their goals. This confirmed that playing World of Warcraft is a cognitive complex task, both for players experiencing the game for the first time and for those who have been playing the game for years. Furthermore, players were required to rapidly switch their attention between sub-tasks requiring different cognitive abilities, necessitating effortful attentional control. World of Warcraft is therefore a good candidate as a cognitive training tool.

Novice		
Task Number	Task	Cognitive Demands
4	Kill targets	goal formation
4.1	See potential target (boar)	visual search, useful field of view, declarative knowledge
4.2	Select boar	
4.2.1	Click on boar	
4.3	Kill boar	
4.3.1	Right click on boar to initiate attack	
4.3.1.1	Realize not close enough to attack	
4.3.1.1.1	Notice and attend to distance warning	visual attention
4.3.1.1.2	Wait for boar to wander within attack distance	problem solving
4.3.2	Attack boar	
4.3.2.1	Assess how the fight is going	divided attention, reasoning
4.3.2.1.1	Decide additional action is needed	decision making
4.3.2.1.2	Use a druid power available on the action bar	hypothesis testing
4.3.2.1.2.1	Select and cast healing touch	
4.3.2.1.2.1	Select and cast healing touch	
4.3.2.1.2.1.1	Click on healing touch icon on action bar	
4.3.2.1	Reassess fight	divided attention, reasoning
4.3.2.2	Attack boar with staff until boar dies	

Figure 1. Excerpt from the CTA of a novice playing World of Warcraft.

Expert		
Task Number	Task	Cognitive Demands
1.1	Kill remaining boar(s)	
1.1.1	Check to see how many boars remain to complete quest	
1.1.1.1	Look at quest kill count on right side of screen	automatic process (reading)
1.1.2	Find target (type of boar specified by quest)	
1.1.2.1	Conduct visual scan of environment for target	visual search, useful field of view
1.1.2.1.1	Discriminate target from distractors (non-target mobs, environment details)	visual search, acuity
1.1.2.1.1.1	Know what target looks like	recognition memory, declarative memory
1.1.3	Engage target in combat	procedural memory
1.1.3.1	Reach ideal range for combat	distance prediction
1.1.3.1.1	Run towards target	
1.1.3.1.2	Stop running when maximum spell distance from target is reached	
1.1.3.1.2.1	Know approximate maximum distance for spell	declarative memory
1.1.3.1.2.2	Notice that spell icon becomes colorful and "active," indicating target is within range	useful field of view, color discrimination
1.1.3.2	Fight target (boar)	
1.1.3.2.1	Cast ranged spell until mana is depleted	
1.1.3.2.1.1	Notice that mana is insufficient to continue casting spell	divided attention
1.1.3.2.1.1.1	Heed visual or audio indicator of mana depletion	automatic process
1.1.3.2.2	Attack with melee weapon	
1.1.3.2.2.1	Switch to melee attack	
1.1.3.2.2.2	Attack boar with staff until boar dies	

Figure 2. Excerpt from the CTA of an expert playing World of Warcraft.

## Hypothesis

World of Warcraft was predicted to improve the cognitive ability of older adults through the gameplay requirements of using multiple cognitive abilities under attentionally



demanding conditions. In particular, it was expected to improve older adults' spatial orientation ability and attentional control because of the high demands for those abilities during play. Other abilities, such as perceptual speed and memory span, were also expected to improve due to the demands of the game. It is hypothesized that initial ability level will affect improvement such that experimental participants exhibiting lower initial ability will improve more than those exhibiting higher initial ability.

## METHOD

### **Participants**

Participants were contacted through a database of older adults who had already participated in psychology research through North Carolina State University and through community newsletters and announcements. For their participation control group participants received \$50.00 at the end of the study and experimental group participants received \$70.00. As a condition of eligibility, all participants in both experimental and control groups had a home computer less than three years of age, and a dedicated home internet connection. The participants recruited for the study were all aged 60 years or older.

Participants completed demographic questionnaires that included questions about their age, gender, frequency of computer use over the past three months, highest level of education completed, and self-assessment of health. There were no significant differences between the control and experimental groups on these demographic measures (Table 1). Participants also completed a series of cognitive ability tests during the pre-testing session. There were no significant differences between the control and experimental groups on these

ability measures at pre-test (Table 2).

Table 1  
*Demographics for Control and Experimental Groups*

	Control Mean	Experimental Mean	Between groups	
			F	p
Age	66.74	68.58	1.44	0.24
Gender			0.40	0.53
Female (Percent)	55%	45%		
Male (Percent)	47.37%	52.63%		
Frequency of computer use <sup>1</sup>	5.94	5.37	2.09	0.16
Education <sup>2</sup>	5.21	4.47	2.32	0.14
Health <sup>3</sup>	3.84	4.16	1.10	0.30

*Note:* <sup>1</sup>Higher scores indicate more frequent computer use; <sup>2</sup>Higher scores indicate more education; <sup>3</sup>Higher scores indicate better self-reported health.

Table 2  
*Pre-test Ability Measures for Control and Experimental Groups*

	Control Mean	Experimental Mean	Between groups	
			F	p
Shipley Vocabulary <sup>1</sup>	35	34	0.83	0.37
Stroop <sup>2</sup>	131.20	132.80	0.03	0.86
Object Perspective <sup>2</sup>	56.50	46.97	0.78	0.38
Digit Symbol Substitution <sup>1</sup>	48.20	47.47	0.04	0.84
Mental Rotation <sup>1</sup>	62.50%	58.10%	0.68	0.41
Reasoning <sup>1</sup>	5.10	5.53	0.33	0.57
ECB Recognition Memory <sup>1</sup>	25.80	24.74	1.25	0.27
Reverse Digit Span <sup>1</sup>	7.30	6.94	0.29	0.59

*Note:* <sup>1</sup>Higher scores indicate better performance; <sup>2</sup>Lower scores indicate better performance

## Materials

**Ability Tests.** Participants completed a series of ability tests during the pre- and post-test sessions to measure initial ability and change over the experimental period.

### *Spatial Tests*

*Mental Rotation Test.* The MRT was a measure of mental rotation ability and consisted of a version of the test made from redrawn Vandenberg & Kuse (1978) images (Peters et al., 1995). The test was composed of 12 questions in which participants indicated which two of four images represent a rotated version of a larger image.

*Object Perspective Test.* The Object Perspective Test (Kozhevnikov & Hegarty, 2001) was a measure of spatial orientation, which is defined as the ability to imagine how a stimulus array will appear from another perspective. It consisted of a configuration of seven objects with an empty circle drawn below. Participants were told to imagine being at the position of one object in the configuration while oriented toward another object, and then asked to draw on the circle the direction of a third object in relation to their current orientation.

*Paper Folding Test.* The Paper Folding Test (Ekstrom, French & Harman, 1976) was a measure of spatial visualization, which was defined as the ability to manipulate complex spatial information when several stages are required to produce the solution (Voyer, Voyer & Bryden., 1995). In the Paper Folding Test participants imagined folding and unfolding pieces of paper. They were presented with a series of illustrations of a piece of paper being folded, with the last picture in each series showing a hole punched in the paper. Participants then mentally unfolded the paper and indicated which of five choices represented the correct location of the hole in the paper once it is completely unfolded. This test was administered during the post-test only.

### *Executive Function*

*Digit Symbol Substitution Test.* The Digit Symbol Substitution Test (Wechsler, 1955) was a measure of perceptual speed. The test consisted of a key of nine digits, one through nine, each paired with a simple symbol. On the same page is a series of random digits, one through nine, with an empty box below each digit. Participants must write in the symbols that corresponds to the digits written above each box as quickly and accurately as possible.

*Stroop Test.* The Stroop Test (Stroop, 1935) was used to measure attentional control. Participants were given a list of color names printed in different colors of ink. They were asked to speak aloud the name of the colors in which the words are printed, not the text of the words themselves. This required the attentional control to ignore the text of the word and focus on the ink.

*Raven's Progressive Matrices.* The test used was a modified version of Raven's Progressive Matrices (Raven, Court & Raven, 1996) to assess nonverbal reasoning ability. The test consisted of a series of images for each question. For some question, participants were asked to identify the pattern in a series of images and pick from multiple options which image would best complete the series. For other questions, they were asked to select one image from a group of image that did not belong in the group.

*Reverse Digit Span Test.* The Reverse Digit Span Test (Wechsler, 1955) was a test of short-term memory and attention. Participants were asked to listen to series of numbers read out loud. After each series was read to them, they were asked to write the numbers in the series down in the reverse of the order in which they were read.

## *Memory*

*Everyday Cognition Battery: Recognition/Declarative Memory Test (ECB: Recognition).* The ECB Recognition Test (Allaire & Marsiske, 1999) was designed to test the cued recall memory of older adult participants. The test consisted of a series of pages of information and pages of questions. For each page of information, there was a following page of multiple-choice questions asking about the information contained on the previous page. The pages of information were of the type that older adults might encounter in their daily lives, such as medicine labels or nutrition labels. Participants were given one minute to study a page of information, and then asked to turn to the next page and take one minute to answer multiple choice questions that require them to remember what they read on the previous page.

## **Equipment**

The training was performed on participants' home computers so hardware specifications varied. However, all computers met the game's minimum system requirements: Windows XP or Windows Vista, Intel Pentium 4 1.3 GHz or AMD Athlon XP 1500+, 512 MB RAM, and ATI Radeon 7200 or GeForce 2 class.

## **Design**

Independent variables used in this study were group assignment (control or

experimental) and initial performance on pre-test ability measures. The dependent measures used were change scores for the abilities, calculated by subtracting pre-test scores from post-test scores.

## **Procedure**

Participants were assigned to either an experimental or control group. Upon arrival for the pre-test session, all participants received two copies of an informed consent form. After reading the form they were asked to sign one copy and keep the other copy for their records. All participants then completed a series of ability tests and questionnaires to measure initial ability and demographic characteristics. Upon finishing the session experimental participants were instructed to return for a training session scheduled within the next few days.

All experimental participants attended a training session. The two-hour training session consisted of an hour-long lecture and demonstration of the game, followed by an hour-long hands-on practice with the game on laptops. Practice was conducted either singly or in pairs where participants took turns operating the game. They were given training materials to assist them, including an illustrated game manual created for the study as well as the official game manual.

Experimental participants then returned home and played the game at home for approximately 14 hours over a two week period, or about an hour a day. During this time they were encouraged to contact the experimenters with any questions, either by phone, email, or within the game itself. A trained experimenter was present within the game for an

hour a day to answer questions. Both experimental and control participants then returned for a second session of ability tests and questionnaires. Experimental participants additionally completed a questionnaire about their experience with the game.

## **RESULTS**

Results include gameplay findings and ability test results. For the ability test results, it was important to take pre-test performance into account because it was expected that pre-test performance would be a significant predictor of post-test performance. It was expected that experimental participants who performed more poorly at pre-test would show more improvement on the post-test, because lower-ability participants should be more susceptible to improvement from the intervention. Therefore, hierarchical regression analyses were performed that used initial ability and group as predictors of ability change scores, with an interaction term of ability x group to examine possible differential relationship between ability and change scores between the two groups. Pre-test ability scores were centered before analysis.

### **Gameplay**

The amount of time experimental participants spent playing the game was tracked automatically within the game. While the average amount of time participants spent playing the game was over the 14 hour target, play time varied between participants ( $M = 14.35$ ,  $SD = 8.01$ ).

One way achievement is measured within the game is by “levels.” Levels are tracked automatically by the game and were recorded at the end of the two-week training period. Each player begins at level one and gains levels through proficient participation in the game. The amount of effort required to reach the next level increases with each level gained. Levels can be seen as a measure of both proficiency and effort within the game. Level achieved within the game varied between participants ( $M = 6.79$ ,  $SD = 3.07$ ). A linear regression analysis found a significant relationship between time spent playing the game and level achieved ( $R^2=0.78$ ,  $F(1,17)= 59.06$ ,  $p<.01$ ).

### **Interaction Effects**

#### *Attentional Control*

Attentional control was measured with the Stroop test. A two-block hierarchical regression analysis was used to examine the relationship between the predictors of initial pre-test Stroop performance and group on Stroop change scores. Because a lower Stroop score indicates better performance, for this analysis Stroop change score was calculated by subtracting the post-test score from the pre-test score, such that more positive change scores indicate more improvement.

The first block consisted of the predictors of group and Stroop pre-test scores. Together these variables accounted for 22.7% of the variance in Stroop change scores ( $R^2=.23$ ,  $F(2,36)=5.28$ ,  $p = .01$ ). Both group ( $\beta =0.31$ ,  $p=.04$ ) and pre-test Stroop score ( $\beta=0.35$ ,  $p=.02$ ) uniquely and significantly predicted Stroop change scores such both experimental participants and participants who started with higher scores (indicating worse



performance) tended to improve more.

To test for an interaction, a second block consisting of the interaction term of pre-test Stroop score and group was added to the model. This model consisting of group, pre-test Stroop score, and the interaction term of these two variables accounted for 35.8% of the variability in Stroop change scores ( $R^2=.36$ ,  $F(3,35)=6.51$ ,  $p<.01$ ). There remained a significant effect for group ( $\beta =0.31$ ,  $p=.03$ ) but not for pre-test Stroop score ( $p=.80$ ). There was a significant interaction between group and Stroop pre-test score such that participants in the experimental condition who had higher Stroop pre-test scores (indicating worse performance) tended to have higher change scores ( $\beta =.48$ ,  $t=2.68$ ,  $p=.01$ ). For participants in the control condition no relationship existed between initial performance and change. These findings indicate that the experimental group, but not the control group, improved differentially on a measure of attentional control based on initial performance. Experimental participants who performed more poorly on the Stroop pre-test (as indicated by higher scores) improved more than participants who performed more highly on the Stroop pre-test.

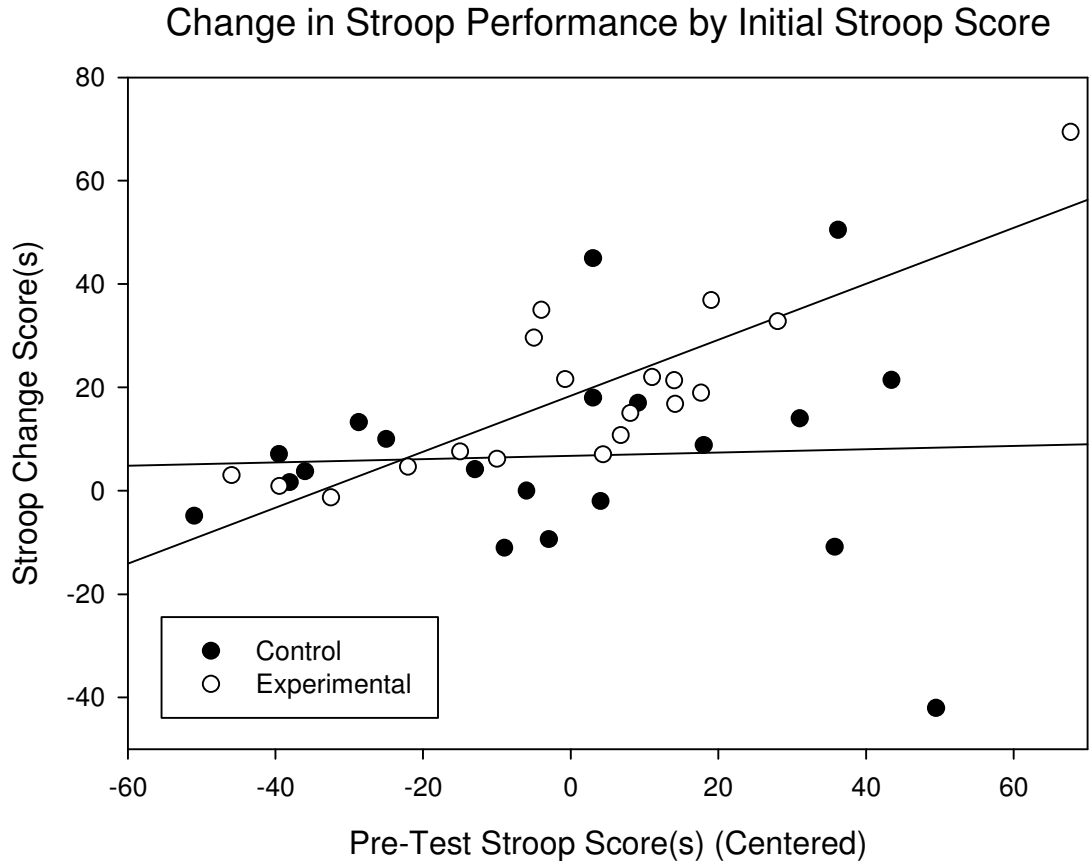


Figure 3. A lower score on the Stroop pre-test indicates better performance. A more positive change score indicates more improvement.

### *Spatial Orientation*

The Object Perspective Test (Kozhevnikov & Hegarty, 2001) was used measure of spatial orientation. A two-block hierarchical regression analysis was used to examine the relationship between the predictors of initial Object Perspective score and group on Object Perspective change. Because a lower score on the Object Perspective Test indicates better performance, the Object Perspective change score was measured by subtracting the post-test score from the pre-test score such that more positive change scores indicate more improvement.

The first block consisted of the predictors of pre-test Object Perspective score and group. Although Object Perspective pre-test score significantly predicted Object Perspective change score ( $\beta=.38, p=.04$ ) the overall model was not found to be significant ( $p=.12$ ). To test for an interaction a second block consisting of the interaction term of pre-test Object Perspective score and group was added to the model. This model significantly accounted for 29.5% of the variance in Object Perspective change scores ( $R^2=.30, F(3,35)=4.88, p<.01$ ). Neither Object Perspective pre-test score ( $p=.30$ ) or group ( $p=.94$ ) significantly predicted change score. However, the interaction term consisting of the two variables was significant ( $\beta=.73, t=3.01, p<.01$ ). These findings indicated that the experimental group, but not the control group, improved differentially on a measure of spatial orientation, such that that participants in the experimental condition with higher pre-test Object Perspective scores (indicating poorer performance) tended to have higher change scores (indicating more improvement).

### Change in Object Perspective Performance by Initial Object Perspective Score

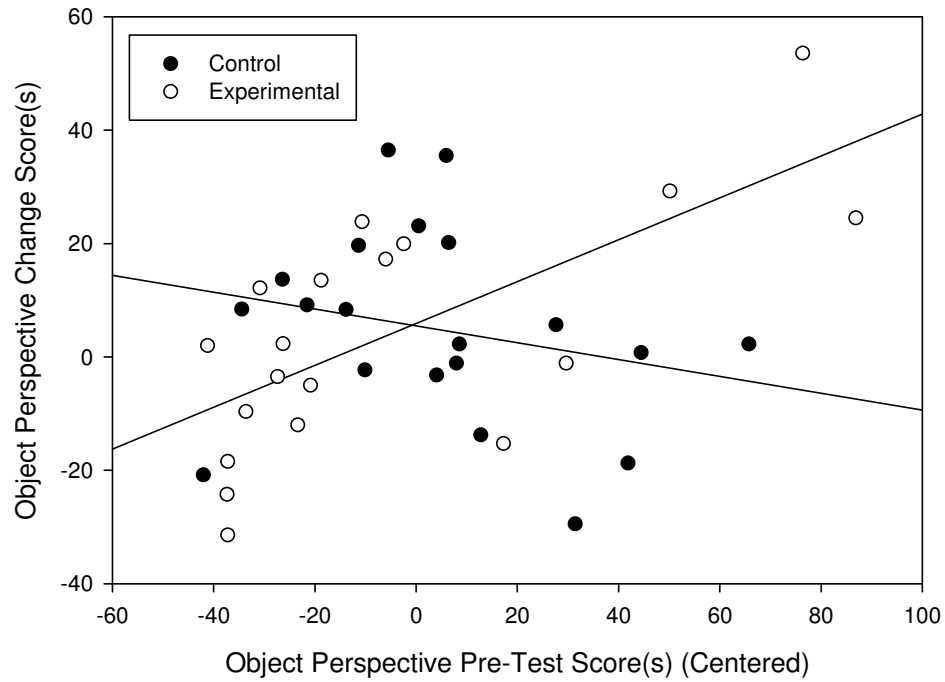


Figure 4. Lower scores on the object perspective test indicated better performance on the test. A more negative change score indicated more improvement on this test.

### Reverse Digit Span

The Reverse Digit Span (RDS) test was used as a measure of memory span and attention. Scores were measured as the number of error-free reversed number series accurately recalled by each participant. RDS change scores were calculated by subtracting the pre-test scores from the post-test scores. Higher RDS pre-test scores indicate better performance, and higher change scores indicate more improvement. A two-block hierarchical regression analysis was used to examine the relationship between the predictors of initial RDS score and group on RDS change scores. Two participants were excluded from the analysis because they completed the task incorrectly.

The first block consisted of the predictors of pre-test RDS score and group. The

overall model was found to significant predict 23.4% of the variance in RDS change scores ( $R^2=.23$ ,  $F(2,34)=5.19$ ,  $p=.01$ ). Pre-test RDS score uniquely and significantly predicted RDS change scores ( $\beta=-.48$ ,  $p<.01$ ) but group did not ( $p=.51$ ). To test for an interaction a second block consisting of the interaction term of pre-test RDS score and group was added to the model. The model consisting of these three variables significant accounted for 33.3% of the variance in RDS change scores ( $R^2=.33$ ,  $F(3,33)=5.50$ ,  $p<.01$ ). Pre-test RDS score remained a significant predictor ( $\beta=-.69$ ,  $p<.01$ ) and again, no unique significance was found for group ( $p=.56$ ). The interaction of pre-test score and group was significant ( $\beta=.38$ ,  $t=2.22$ ,  $p=.03$ ) such that a differential relationship between pre-test RDS score and RDS change score existed for the two groups. For participants in the control group, but not in the experimental group, lower pre-test RDS scores (indicating worse performance) tended to be associated with higher change scores (indicating more improvement).

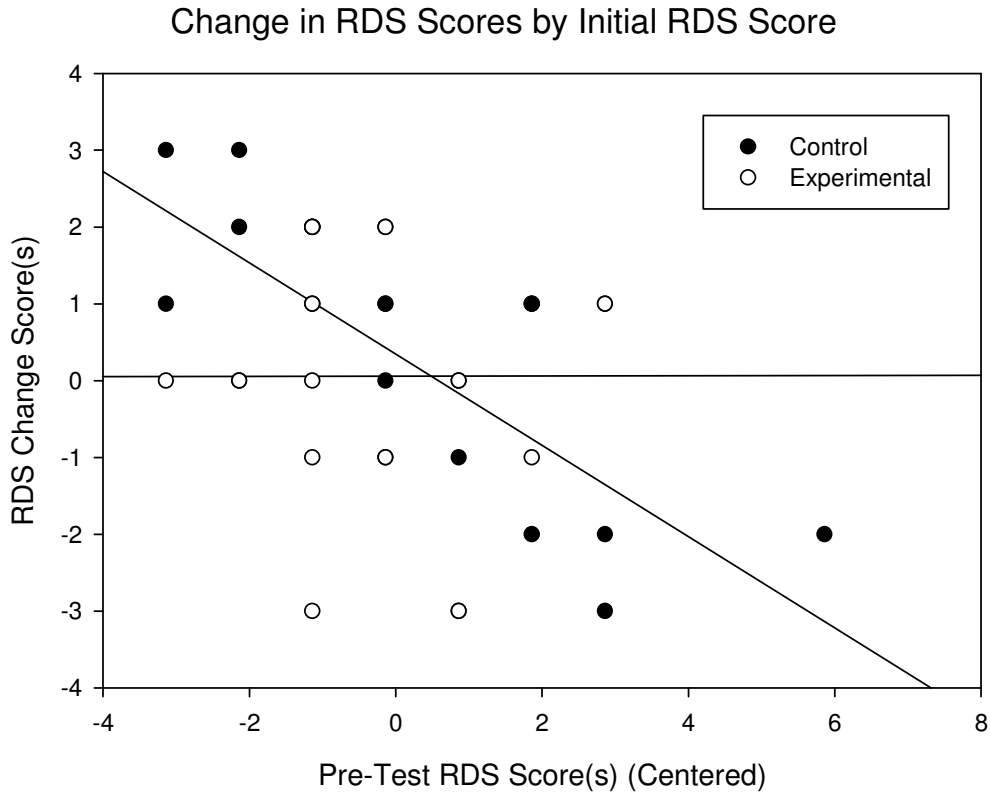


Figure 5. Higher pre-test scores indicate better performance. A more positive change score indicates more improvement.

## Main Effects

### Reasoning

Multiple regression analysis consisting of the predictors of group, pre-test Reasoning score, and the interaction of the two variables was conducted to determine the predictors' unique effect on Reasoning change score. The overall model significantly explained 62% of the variance in Reasoning change score ( $R^2=.62$ ,  $F(2,36)=19.04$ ,  $p<.01$ ). There was a significant main effect for pre-test Reasoning score ( $\beta=-.69$ ,  $p<.01$ ) such that participants who had lower pre-test scores tended to improve more. No significant main effect was found

for group ( $p=.11$ ) or the interaction term ( $p=.55$ ).

### *ECB Recognition*

Multiple regression analysis consisting of the predictors of group, pre-test Everyday Cognition Battery: Recognition (ECB Recognition) and the interaction of the two variables was conducted to determine the predictors' unique effect on ECB Recognition change score. The overall model significantly explained 42% of the variance in ECB Recognition change scores ( $R^2=.42$ ,  $F(2,36)=8.40$ ,  $p<.01$ ). There was a significant main effect of pre-test ECB Recognition score ( $\beta=-.71$ ,  $p<.01$ ) such that participants who had lower pre-test scores tended to improve more. No significant main effect was found for group ( $p=.63$ ) or the interaction term ( $p=.70$ ).

### **Non-Significant Findings**

Multiple regression analysis with an interaction term was performed for Digit Symbol Substitution scores to look for potential interactions of group and pre-test DSS score on DSS change score. No significant main effects were found for group ( $p=.86$ ) or pre-test DSS score ( $p=.36$ ) or for the interaction term of the two variables ( $p=.25$ ).

The Paper Folding Test was performed only at post-test. A one-way ANOVA found no significant difference between control and experimental groups on Paper Folding post-test performance ( $F(1,36)=1.50$ ,  $p=.23$ ).

## **Subjective Experience**

### *Quantitative*

After completing the post-test, participants in the experimental condition completed an exit questionnaire describing their experience with the game. They were asked to indicate the extent to which they agreed or disagreed with statements about the interface's ease-of-use, enjoyment of the game, and enjoyment of the social aspects of the game. The 5-point Likert scale ranged from “Strongly Disagree” at one to “Strongly Agree” at five. Participants very slightly agreed that the interface was easy to use with a mean response of 3.13 (SD = 0.89), and also very slightly agreed that the game was fun with a mean response of 3.18 (SD = 0.88). They slightly disagreed with the statement that they enjoyed the social aspects of the game, with a mean response of 2.65 (SD = 1.00).

### *Qualitative*

The exit questionnaire for experimental participants also contained a number of open ended free-response questions. Participants were asked if they thought playing the game improved their cognitive abilities, and if so, which abilities they thought it improved. They were also asked if they thought the interface could be improved, and if so, how to improve it.

The general perception of the participants was that playing the game did in fact improve their cognitive abilities. Seventeen experimental participants completed the questionnaire. 59% reported that they felt the game did improve their cognitive abilities, 18% were unsure, and 26% reported no improvement. 76% listed abilities they felt were



improved as a result of the game. After coding their free responses as cognitive abilities (e.g. the response of “the art of finding ways to solve problems” was coded as reasoning ability and “sense of direction” was coded as spatial ability), as a whole participants reported improvement in six different kinds of cognitive abilities: attention (reported by 18%), memory (18%), spatial abilities (18%), hand-eye coordination (18%), reasoning (12%), and reaction time (18%). Most participants reported improvement in a single ability, although of the 13 who listed abilities they felt were improved, 38% listed more than one ability.

Some participants also provided suggestions on how to improve the game's interface. One participant suggested using on-screen icons that could be clicked on to chat with a specific player, rather than the game's method of requiring a message to be prefaced with a command to send a message to that player. Another reported that the text in the chat window was difficult to read, perhaps because the game defaults to a 12-point font on a semi-transparent background. However, the most common complaint was the lack of instruction within the game and interface.

## DISCUSSION

Using a video game as a cognitive training tool for older adults is not a novel approach (e.g. Basak et al., 2008), although the results of this study add to the body of evidence suggesting the efficacy of certain types of video games as cognitive interventions. This study also highlights the importance of initial ability level when considering the pattern of expected improvement from a cognitive intervention. Playing World of Warcraft was

found to improve certain cognitive abilities in older adults, with attentional control and spatial orientation ability, and mental rotation ability demonstrating significant improvement. The degree of change for these abilities for the experimental group was found to differ by initial pre-test performance, such that lower-scoring participants improved more on the post-test. Even in a relatively young, educated and high-functioning sample of older adults, those with lower ability have the potential to benefit from such an intervention.

However, there is contradictory evidence in the findings. For the Reverse Digit Span (RDS) Test, the control group was found to differentially improve based on pre-test performance, while no such relationship existed for the experimental group. This could reflect an issue with the administration of the test. Because of the nature of the RDS Test, it is possible to receive a high score by following the instructions incorrectly. During administration of the test no experimenters were explicitly assigned to watch for participants completing the test incorrectly. Two participants were excluded from the analysis because an experimenter seated nearby observed them completing the test incorrectly; however, more may have been excluded if this had been explicitly monitored.

One limitation of our study is that it did not utilize random assignment because of the difficulty encountered recruiting participants who met the requirements (i.e. older adults owning a recently-purchased home computer with a broadband internet connection). Participants were assigned to groups in a non-random convenience assignment depending on their availability for the testing sessions. Post-hoc tests of pre-test performance in both groups revealed no significant differences, nor were there significant differences in demographics between the two groups, which makes us more confident the groups were

equivalent. However, differences in testing location by group may have contributed the contradictory RDS Test results because in some locations the participants were clustered more closely around the experimenter, and may have been more likely to adhere to the instructions for that test.

It should also be said that ideal intervention studies feature a control condition that contains an intervention while remaining distinct from the intervention examined in the experimental group, to reduce the motivational effects of simply taking part in an intervention (Green, Li, & Bavelier, 2010; Lied & Karzandjian, 1998). Our study utilized a control group but no “intervention-like” group to compare to our target intervention. Future studies of the use of video games as a cognitive intervention for older adults should incorporate a control condition utilizing a video game not expected to lead to improvement (e.g. Feng et al., 2007; Green & Bavelier, 2003).

### *Practical Implications*

The practical findings of this study are twofold. First, older adults will play a cognitive intervention game despite reporting little enjoyment of the game. Furthermore, enjoyment of the intervention was not necessary for cognitive improvement. Although the ideal cognitive intervention should be enjoyable, in the short-term it is possible to implement successful interventions using tasks that may be too challenging to be fun.

Given the adherence we observed over the two-week intervention period, it seems likely motivating factors other than enjoyment were responsible. Participants may have felt obligated to continue after committing to the study. They may also have been motivated by

the desire to improve their cognitive abilities. At the post-test, a relatively high proportion of the experimental group reported the belief that their abilities had improved as a result of playing the game. Future studies might examine how initial expectations influence variables like motivation, adherence, and even cognitive improvement throughout a longer intervention.

Second, our intervention was successfully administered remotely with little intervention from experimenters. Although participants could always contact the experimenters through e-mail, phone, or within the game itself, after the initial training session our intervention did not require the in-person supervision of participants during play. Participants were largely compliant with the amount of time they were asked to play and were able to engage in the game on their own schedule and at their own pace.

### *Theoretical Contributions*

There were two major theoretical contributions of this study. First, a game selected because of its attentional demand and social opportunities was found to improve the cognitive abilities of older adults. World of Warcraft afforded players many social opportunities because of its collaborative nature, and to examine the attentional and cognitive demands of the game a cognitive task analysis (CTA) of novice and expert gameplay was conducted prior to the study. We still do not know the extent to which these two factors contributed to the demonstrated improvement because they were not manipulated as part of the study. Past studies showed that surface features of a game may be misleading when considering their potential to improve cognitive ability, e.g. one 3D puzzle game

demonstrating improvement of mental rotation ability (De Lisi & Cammarano, 1996) and a different 3D puzzle game showing no effect (Feng, Spence & Pratt, 2007), but the use of CTA in examining games as potential tools for cognitive intervention is a novel approach that may aid in selecting effective cognitive training games.

Second, improvement depended not only on treatment but on initial ability levels. We found that amount of improvement was related to initial ability level, such that lower initial ability was associated with greater improvement. Furthermore, this relationship between initial ability and improvement was either found exclusively in the experimental condition (in the case of attentional ability and spatial orientation ability) or made stronger by the experimental condition (in the case of mental rotation ability). In the literature there is some debate as to who can benefit most from cognitive training. Some would argue that cognitive interventions can most benefit younger and consequently higher-functioning individuals due to increased neural plasticity (Nyberg, 2005), while others would suggest that while older and lower-functioning individuals might benefit from cognitive interventions, high-functioning individuals may not (Salthouse, Berish & Miles, 2002).

The results of this study support the idea that lower-ability participants have more potential to benefit from cognitive interventions. Because we saw the most cognitive improvement among the lower-functioning participants, our findings generally support the idea that lower-functioning individuals may benefit more from cognitive interventions. However, because our participants were relatively young and high-functioning for older adults, this does not rule out the possibility of an ideal range for benefit from cognitive intervention – i.e. initial ability low enough to benefit, but young and high-ability enough to

have the plasticity to support change. Further investigation is needed to clarify the relationship between initial ability level and improvement from cognitive interventions.

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## APPENDICES

## APPENDIX A

### *Consent Form*

North Carolina State University  
INFORMED CONSENT FORM for RESEARCH

Social Game Cognitive Training

Dr. Jason Allaire

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We are asking you to participate in a research study. The purpose of this study is to understand the factors that may lead to improved cognitive function in older adults.

### **INFORMATION**

If you agree to participate in this study, you will be asked to attend three sessions at our offices and play an online, multiplayer game on your home computer for two weeks. The first session will last approximately two and a half hours and consist of taking surveys and ability tests. The second session will last approximately two hours, and during it you will meet other people who are participating in the study and learn how to play the game.

You will be given a copy of the game and full instructions on how to play it, and over the following two weeks you will be asked to play the game at home for at least an hour a day. During this time, we will be available to assist you by phone, e-mail, and in the game itself.

After the two weeks you will return for a final session in our office, lasting approximately two hours, where you will take more ability tests and answer questions about your experience taking part in the study.

### **RISKS**

Participation in this study involves minimal risk or discomfort to you. Risks are minimal and do not exceed those of normal work. Please tell us if you are having any sort of trouble with any task.

## **BENEFITS**

There are no direct benefits to participating in the study. After the end of the study, we will share the results with you by mailing a newsletter to all the participants.

## **CONFIDENTIALITY**

The following procedures will be followed to keep your personal information confidential in this study: The data that are collected about you will be kept private to the extent allowed by law. To protect your privacy, your records will be kept under a code number rather than by name. Your records will be kept in locked files and only study staff will be allowed to look at them. Your name and any other fact that might point to you will not appear when results of this study are presented or published. No reference will be made in oral or written reports which could link you to the study.

## **COMPENSATION**

For participating in this study you will receive \$70.00. If you withdraw from the study prior to its completion, you will receive compensation proportional to the portion of the study completed.

## **EMERGENCY MEDICAL TREATMENT**

If injury occurs during your normal working activities, please contact your family doctor. Neither North Carolina State University nor the principal investigator has made provision for payment of costs associated with any injury resulting from participation in this study.

## **CONTACT**

If you have questions at any time about the study or the procedures, you may contact the researcher, Laura Whitlock, at lawhitlo@ncsu.edu, or (919) 923-3933. If you feel you have not been treated according to the descriptions in this form, or your rights as a participant in research have been violated during the course of this project, you may contact Deb Paxton, Regulatory Compliance Administrator, Box 7514, NCSU Campus (919/515-4514), or Joe Rabiega, IRB Coordinator, Box 7514, NCSU Campus (919/515-7515).

**PARTICIPATION**

Your participation in this study is voluntary; you may decline to participate without penalty. If you decide to participate, you may withdraw from the study at any time without penalty and without loss of benefits to which you are otherwise entitled. If you withdraw from the study before data collection is completed your data will be returned to you or destroyed at your request.

**CONSENT**

“I have read and understand the above information. I have received a copy of this form. I agree to participate in this study with the understanding that I may withdraw at any time.”

**Subject's signature**\_\_\_\_\_

**Date** \_\_\_\_\_

**Investigator's signature**\_\_\_\_\_

**Date** \_\_\_\_\_



**APPENDIX B**

*Demographic and Health Questionnaire*

Date \_\_\_\_\_  
Participant number \_\_\_\_\_

Please answer the following questions. All of your answers will be treated confidentially. Any published document regarding these answers will not identify individuals with their answers. If there is a question you do not wish to answer, please just leave it blank and go on to the next question. Thank you in advance for your help.

**Demographics and Health Questionnaire**

**Date of Birth:** \_\_\_\_/\_\_\_\_/\_\_\_\_  
                            Month   Day    Year

**Gender:**  <sub>1</sub> Male     <sub>2</sub> Female

**1. Education completed (check highest level)**

- 1 Less than high school graduate  
(highest grade completed? \_\_\_\_\_ )
- 2 High school graduate/G.E.D.
- 3 Some college, or trade, technical, or business school  
(how many years? \_\_\_\_\_ )
- 4 Bachelor’s degree
- 5 Some graduate work (how many years? \_\_\_\_\_ )
- 6 Master’s degree
- 7 M.D., J.D., Ph.D., other advanced degree

**2. Current marital status (check one)**

- 1 Single
- 2 Married
- 3 Separated
- 4 Divorced
- 5 Widowed
- 6 Other (please specify \_\_\_\_\_ )

**3. Race/ethnicity**

- 1 Black/African American
- 2 Asian American/Pacific Islander
- 3 White/Caucasian
- 4 Hispanic/Latino
- 5 American Indian/Alaskan Native
- 6 Multiracial (please specify \_\_\_\_\_ )
- 7 Other (please specify \_\_\_\_\_ )

**4. In which type of housing do you live?**

- 1 Residence hall/College dormitory
- 2 House/Apartment/Condominium
- 3 Senior housing (independent)
- 4 Assisted living
- 5 Nursing home
- 6 Relative's home
- 7 Other (please specify \_\_\_\_\_ )

**5. Do you live alone a majority of the year?**

- 1 Yes
- 2 No

**6. What is your primary language?**

- 1 English
- 2 Spanish
- 3 French
- 4 Creole
- 5 Portuguese
- 6 Other (please specify \_\_\_\_\_ )

**7. Occupational status (check all that apply)**

- 1 Working full-time
- 2 Working part-time
- 3 Student
- 4 Homemaker
- 5 Retired
- 6 Volunteer worker
- 7 Seeking employment, laid off, etc.
- 8 Leave of absence
- 9 Other (please specify \_\_\_\_\_ )

**8. What is your current occupation?** \_\_\_\_\_

**9. If retired:**

**a. What was your primary occupation?** \_\_\_\_\_

**b. What year did you retire?** \_\_\_\_\_

## Health Information

**10. In general would you say your health is:**

<input type="checkbox"/> 1	<input type="checkbox"/> 2	<input type="checkbox"/> 3	<input type="checkbox"/> 4	<input type="checkbox"/> 5
Poor	Fair Excellent	Good	Very Good	

**2. Compared to other people your own age, would you say your health is:**

<input type="checkbox"/> 1	<input type="checkbox"/> 2	<input type="checkbox"/> 3	<input type="checkbox"/> 4	<input type="checkbox"/> 5
Poor	Fair Excellent	Good	Very Good	

**3. Do you take any medications (prescription or nonprescription) on a regular basis (at least once a week)?**

<input type="checkbox"/> 1 Yes	<input type="checkbox"/> 2 No
--------------------------------	-------------------------------

**4. Please check which of following conditions you have now or have had in the past.**

Condition	In Your Lifetime <sub>1</sub>	Now 2
a. Asthma or Bronchitis		
b. Cancer (other than skin cancer)		
c. Chronic liver disease or hepatitis		
d. Chronic migraine headaches		
e. Diabetes		
f. Emphysema		
g. Encephalitis or meningitis		
h. Epilepsy		
i. Heart attack or bypass surgery		
j. Heart problems		
k. High blood pressure		
l. Kidney disease		
m. Leukemia		
n. Multiple sclerosis		
o. Parkinson's disease		
p. Pneumonia		
q. Rheumatoid arthritis or other autoimmune disorders		
r. Stomach ulcers		
s. Stroke		
t. Other significant illnesses (please list)		

Medication Usage Details

Please list all medical products that you are currently taking. Include medicinal herbs, vitamins, aspirin, antacid, nasal spray, laxatives, etc., as well as prescription medications (copy names from label if possible). This information will be completely confidential.

**EXAMPLE**  
Name of Medication: Zarontin  
Reason for taking: epilepsy Dosage (ea. Time taken): 500 mg  
How often do you take the medication? (circle one)  
daily every other day weekly as needed  
On days that you take the medication, how many times per day do you take it? 3  
What time of day do you take the medication? Morning, afternoon, evening  
How long you have been taking the medication? 5 years  
Does this medication cause any problems? Makes me sleepy

1. Name of Medication: \_\_\_\_\_  
Reason for taking: \_\_\_\_\_ Dosage (ea. Time taken): \_\_\_\_\_  
How often do you take the medication? (circle one)  
daily every other day weekly as needed  
On days that you take the medication, how many times per day do you take it? \_\_\_\_\_  
What time of day do you take the medication? \_\_\_\_\_  
How long you have been taking medication? \_\_\_\_\_  
Does this medication cause any problems? \_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

2. Name of Medication: \_\_\_\_\_  
Reason for taking: \_\_\_\_\_ Dosage (ea. Time taken): \_\_\_\_\_  
How often do you take the medication? (circle one)  
daily every other day weekly as needed  
On days that you take the medication, how many times per day do you take it? \_\_\_\_\_  
What time of day do you take the medication? \_\_\_\_\_  
How long you have been taking medication? \_\_\_\_\_  
Does this medication cause any problems? \_\_\_\_\_  
\_\_\_\_\_

3. Name of Medication: \_\_\_\_\_  
Reason for taking: \_\_\_\_\_ Dosage (ea. Time taken): \_\_\_\_\_  
How often do you take the medication? (circle one)  
daily every other day weekly as needed  
On days that you take the medication, how many times per day do you take it? \_\_\_\_\_  
What time of day do you take the medication? \_\_\_\_\_  
How long you have been taking medication? \_\_\_\_\_  
Does this medication cause any problems? \_\_\_\_\_  
\_\_\_\_\_

4. Name of Medication: \_\_\_\_\_  
Reason for taking: \_\_\_\_\_ Dosage (ea. Time taken): \_\_\_\_\_  
How often do you take the medication? (circle one)  
                  daily    every other day    weekly    as needed  
On days that you take the medication, how many times per day do you take it? \_\_\_\_\_  
What time of day do you take the medication? \_\_\_\_\_  
How long you have been taking medication? \_\_\_\_\_  
Does this medication cause any problems? \_\_\_\_\_  
\_\_\_\_\_

5. Name of Medication: \_\_\_\_\_  
Reason for taking: \_\_\_\_\_ Dosage (ea. Time taken): \_\_\_\_\_  
How often do you take the medication? (circle one)  
                  daily    every other day    weekly    as needed  
On days that you take the medication, how many times per day do you take it? \_\_\_\_\_  
What time of day do you take the medication? \_\_\_\_\_  
How long you have been taking medication? \_\_\_\_\_  
Does this medication cause any problems? \_\_\_\_\_  
\_\_\_\_\_

6. Name of Medication: \_\_\_\_\_  
Reason for taking: \_\_\_\_\_ Dosage (ea. Time taken): \_\_\_\_\_  
How often do you take the medication? (circle one)  
daily every other day weekly as needed  
On days that you take the medication, how many times per day do you take it? \_\_\_\_\_  
What time of day do you take the medication? \_\_\_\_\_  
How long you have been taking medication? \_\_\_\_\_  
Does this medication cause any problems? \_\_\_\_\_  
\_\_\_\_\_

7. Name of Medication: \_\_\_\_\_  
Reason for taking: \_\_\_\_\_ Dosage (ea. Time taken): \_\_\_\_\_  
How often do you take the medication? (circle one)  
daily every other day weekly as needed  
On days that you take the medication, how many times per day do you take it? \_\_\_\_\_  
What time of day do you take the medication? \_\_\_\_\_  
How long you have been taking medication? \_\_\_\_\_  
Does this medication cause any problems? \_\_\_\_\_  
\_\_\_\_\_



8. Name of Medication: \_\_\_\_\_  
Reason for taking: \_\_\_\_\_ Dosage (ea. Time taken): \_\_\_\_\_  
How often do you take the medication? (circle one)  
                  daily    every other day    weekly    as needed  
On days that you take the medication, how many times per day do you take it? \_\_\_\_\_  
What time of day do you take the medication? \_\_\_\_\_  
How long you have been taking medication? \_\_\_\_\_  
Does this medication cause any problems? \_\_\_\_\_  
\_\_\_\_\_

9. Name of Medication: \_\_\_\_\_  
Reason for taking: \_\_\_\_\_ Dosage (ea. Time taken): \_\_\_\_\_  
How often do you take the medication? (circle one)  
                  daily    every other day    weekly    as needed  
On days that you take the medication, how many times per day do you take it? \_\_\_\_\_  
What time of day do you take the medication? \_\_\_\_\_  
How long you have been taking medication? \_\_\_\_\_  
Does this medication cause any problems? \_\_\_\_\_  
\_\_\_\_\_

## APPENDIX C

### *Technology and Computer Experience Questionnaire*

#### **Technology and Computer Experience Questionnaire**

*The purpose of this questionnaire is to assess your familiarity and experience with technology. Please answer all questions by placing a check mark at the appropriate response.*

1. Please check all of the following devices that you have used.

- <sub>a</sub> Answering Machine
- <sub>b</sub> Cellular Phone
- <sub>c</sub> Compact Disk Player
- <sub>d</sub> Copy Machine
- <sub>e</sub> Cruise Control (in your car)
- <sub>f</sub> Fax Machine
- <sub>g</sub> Microwave Oven
- <sub>h</sub> On-line Card Catalog System (at the library)
- <sub>i</sub> Phone-in Banking (e.g., press "1" for "yes")
- <sub>j</sub> Video Cassette Recorder
- <sub>k</sub> Video Camera
- <sub>l</sub> Voice Mail
- <sub>m</sub> Automatic Teller Machines
- <sub>n</sub> Home Securities Systems
- <sub>o</sub> Pay at the Pump Systems
- <sub>p</sub> Clock Radio/Alarm
- <sub>q</sub> Video Arcade Games
- <sub>r</sub> ----- *None of the Above* -----

2. Please check which of the following items you own.

- <sub>a</sub> Answering Machine
- <sub>b</sub> Cellular Phone
- <sub>c</sub> Compact Disk Player
- <sub>d</sub> Cruise Control (in your car)
- <sub>e</sub> Fax Machine
- <sub>f</sub> Microwave Oven

- <sub>g</sub> Video Cassette Recorder
- <sub>h</sub> Video Camera
  
- <sub>i</sub> Clock Radio/Alarm
- <sub>j</sub> Home Computer
- <sub>k</sub> ----- *None of the Above* -----

3. Have you had any experience with computers?  
 Yes             No

**If you answered No, please skip to page 13.**

4. Of the input devices listed below, please indicate **ALL** devices with which you have had experience (check all that apply).

- <sub>a</sub> Keyboard
- <sub>b</sub> Mouse
- <sub>c</sub> Light-pen
- <sub>d</sub> Trackball
- <sub>e</sub> Touch Screen
- <sub>f</sub> Voice Input System
- <sub>g</sub> Joystick
- <sub>h</sub> ----- *None of the Above* -----

5. Indicate the total length of time you have used computers.

- <sub>1</sub> Less than 6 months
- <sub>2</sub> 6 months but less than 1 year
- <sub>3</sub> 1 year but less than 3 years
- <sub>4</sub> 3 years but less than 5 years
- <sub>5</sub> At least 5 years

6. In the past, what was the highest frequency of your computer use over any 3-month period?

- <sub>1</sub> Once every few months
- <sub>2</sub> Every month
- <sub>3</sub> Once per week

- <sub>4</sub> Several days per week
- <sub>5</sub> Daily, but infrequently during the day
- <sub>6</sub> Daily, frequently during the day
- <sub>7</sub> Daily, most of the day

7. Have you used a computer in the last three months?  
 Yes       No

If **Yes**, how frequently?

- <sub>1</sub> Less than one hour a week
- <sub>2</sub> 1 hour but less than 5 hours a week
- <sub>3</sub> 5 hours but less than 10 hours a week
- <sub>4</sub> 10 hours but less than 15 hours a week
- <sub>5</sub> At least 15 hours a week

If **No**, when was the last time you used the computer?

- <sub>1</sub> Less than 6 months ago
- <sub>2</sub> 6 months, but less than a year ago
- <sub>3</sub> 1 year but less than 3 years ago
- <sub>4</sub> 3 years but less than 5 years ago
- <sub>5</sub> At least 5 years ago

8. Of the basic computer operations listed below, please indicate all with which you are proficient (check all that apply).

- <sub>a</sub> insert a disk
- <sub>b</sub> open a file
- <sub>c</sub> delete a file
- <sub>d</sub> save a file
- <sub>e</sub> transfer files
- <sub>f</sub> use a printer
- <sub>g</sub> ----- *None of the Above* -----

9. Of the items listed below, please indicate all with which you are proficient (check all that apply).

- <sub>a</sub> Computer graphics (e.g., Photoshop, Harvard Graphics, AutoCAD)
- <sub>b</sub> Database management (e.g., Access, Filemaker, Lotus 123, etc.)
- <sub>c</sub> DOS

- <sub>d</sub> Electronic mail
- <sub>e</sub> Macintosh
- <sub>f</sub> Presentation software (e.g., PowerPoint, Freelance, etc.)
- <sub>g</sub> Programming package (e.g., Basic, C++, Fortran, etc.)
- <sub>h</sub> Spreadsheet (e.g., Excel, Quattro Pro, etc.)
- <sub>i</sub> Statistical package (e.g., SPSS, SAS, etc.)
- <sub>j</sub> UNIX
  
- <sub>k</sub> Windows
- <sub>l</sub> Word processing (e.g., Microsoft Word, WordPerfect, etc.)
- <sub>m</sub> Other (please specify) \_\_\_\_\_
- <sub>n</sub> ----- *None of the Above* -----

## APPENDIX D

### *Installation and Training Guide*

#### **Installation Guide**

Find package labeled game DVD-Rom.

Insert Disc.

Wait until menu appears.

Click “Install World of Warcraft.”

Scroll down to bottom of License Agreement and click accept.

Choose directory and hit okay.

-Make sure “Place Shortcut” is checked off.

Wait for game to install.

Hit play or click on icon to load the game.

A patch will automatically download.

Wait for the patch download and then wait for the update to install.

Repeat until all patches are installed.

### How to get help:

**Option 1:** Call the LACElab and ask for Laura or John.

They will be available from (*TBD*) time each day until (*TBD*) specifically to help you with any computer issues. The number is 513-2709.

**Option 2:** Email us! We will respond within 24 hours. Lace.lab@gmail.com

**Option 3:** Ask a question inside the game. Laura and John will be available to chat with inside the game from (*TBD*) time each day until (*TBD*).

**\*\*\*Remember, no one from the study or any legitimate source would ever ask you for personal or financial information. Never give out your personal information, such as your address, or credit card number online.\*\*\***

## Welcome to the World of Warcraft Study!

### **Starting the Game**

In order to start your World of Warcraft adventure, double-click the World of Warcraft icon and then type in your Account Name and Password on the main screen. Occasionally the game needs to do maintenance on certain servers so your character may be unavailable from time to time, but this is rare.

My account name is:

---

My password is:

---

My server is:

---

## **Basic Playing Instructions:**

### **Looking**

Hold Right Mouse in order to position your character and your camera simultaneously. Use Left Mouse to position just your camera. Use the middle mouse wheel to zoom in and out.

### **Moving**

To move, you may use the arrow keys on your keyboard. To turn right, you can hold right and up. To turn left, you can hold left and up.

### **Jumping**

To jump, press the space bar. You can also run and jump at the same time to jump over some obstacles.

### **Using your Mouse as a Cursor**

Your mouse is your main tool for manipulating your environment. It looks like a glove on the screen and is used to interact with people, items and fight enemies. The words cursor and mouse are interchangeable. Moving your cursor over something means 'mousing over' it. Holding down left click while moving your mouse is described as 'dragging'. Note that left click and right click both have different features and they are not the same. If you are clicking on something and it doesn't have the intended effect, make sure you're using the correct button for the action.

### **Health**

The green bar to the upper left corner of your screen is the amount of health you have. Below is a picture of how health looks in the game. We enlarged it and labeled it in the picture so you can more easily see what it looks like.





The more health you have, the more times your character can be hit by your enemies. Every time you are hit you will lose some health. While you are not fighting an enemy, your health will slowly come back. If you lose all of your health, your character will be incapacitated.

#### Summary of HEALTH:

- Health is the green bar on the top left corner of your character.
- Health comes back when you are not fighting an enemy.
- You can eat food to heal faster while not fighting.
- You can cast certain healing spells to regain health even while in combat!
- Watch your health! Don't be afraid to run away from a fight if your health is getting low.

#### Mana

“Mana” is your energy, it allows you to cast spells. The blue bar on the left of your character is the amount of mana you have. It is labeled with the blue arrow in the picture above. Every time you cast a spell, it uses some mana. If you

don't have enough mana to cast a spell, you can't cast a spell until you get more.

### Summary of MANA:

- Mana is the blue bar on the right of your character.
- Mana comes back when you are not fighting an enemy.
- You can drink beverages to regain mana if you are not fighting.
- Mana comes back slowly, but automatically.
- Many spells and abilities use mana, this is called their Mana Cost, and can be displayed if you let the cursor hover over the icon for the spell.
- You should not be alarmed if you run low on mana.

### Fighting

To start attacking the enemy, position the mouse over your enemy until you see a sword and then click the RIGHT mouse button. As soon as you click, you will start hitting the enemy if you are close enough. Look at the picture below to see what a sword cursor looks like.



You do not have to click again to keep attacking the same target. In order to defeat an opponent, you must lower its health to 0, but you are defeated if your

health hits 0. The enemy's health bar is the green bar on the right side of your health meter (the blue bar).

Once you conquer an enemy, put your mouse cursor over the creature. It will turn into a picture of a bag. RIGHT click your mouse to gather “loot” from the enemy that you can use later in the game.



The picture above shows what the “loot” cursor will look like.

#### Summary of Fighting:

- Right click over the enemy to attack.
- You do not have to keep clicking; your character will attack continuously, leaving you free to cast spells and abilities.
- Make sure your target is close enough **AND** in front of you or else you won't be able to hit it.
- The goal of fighting is to reduce your enemy's Health to 0.

- Your enemy's health will be the red bar on the left, beside your character's health.
- Be sure to "loot" any conquered creatures by RIGHT clicking on the defeated creature.

### **Reviving your character**

If you are ever defeated, your character's 'ghost' will pop up near a Spirit Healer. In order to revive your character, you will have to find where your character was incapacitated, and then click "Accept" to revive. While you are a 'ghost', you cannot fight or interact with the environment. If you have difficulty finding your body, you can talk to a Spirit Healer and allow her to re-start you, but this will cost you a little of your protective armor.

Summary of Reviving your Character:

- You become a ghost when your health goes down to 0.
- To revive your character, move your ghost to where you were last.
- Talk to a spirit healer if you ever can't reach your body.

### **Quests**

A Quest is a mission inside the game. You can find a quest by talking to people in the game who have a yellow "!" over their heads. Look at the picture below to see what someone offering a quest looks like.



Quests can have numerous objectives, including gathering items from the ground or from enemies, using items on something or someone, talking or bringing something to another person, or incapacitating a number of certain enemies. To finish a quest, you'll need to return to the person who gave it to you. You can always take notes on the quest and keep that paper beside your computer while you play!

#### Summary of How Quests work:

- Listen to what the quest giver tells you. They will give you information about where to go.
- After you accept a quest, any quest-related things that you do will appear as text on the right side of your screen.
- You can always take notes on what quests you are currently performing!

## **Abilities**

Your character has unique spells and abilities. Some you will start out with. Others you will learn over time. Most abilities cost mana. The amount of mana an ability uses is displayed when you place the mouse over the ability on your bars. Abilities will either instantly take effect or take several seconds to 'cast'. When you are using an ability that takes time to cast, a yellow bar displaying the spell you are casting will appear under your character and fill up. When it is filled, your spell will automatically cast. During this time if you move or hit escape, you will stop your spell from casting. You can also not use other abilities while casting.

- Abilities have varying effects. Mouse over them to learn more!
- Some abilities have a cast time.
- While casting you cannot move, hit escape, or use other spells, or it will stop casting.

## **How to Exit the Game**

When you wish to quit the game, click on the Menu option or hit the Escape key, and select Exit Game or Log Out. Logging out takes you back to your character screen. Exit Game will close the entire game. If you wish to take a quick break, logging out might be a better option than exiting the game. It will take the game 20 seconds to successfully log out or exit the game.

Don't worry about saving your progress, the game progressively saves your character's information. Finally when your character is logged out, they will rest. The next time you log in they will temporarily gain experience faster proportional to the time they were resting.

### **Summary of Exiting the Game:**

- Hit the Escape key and select Log Out or Exit Game.
- Logging Out is great for quick breaks.
- It takes 20 seconds to log out or exit.
- Your character is saved automatically.

This next section is not crucial when you begin the game. This is meant to serve as a guide should you desire more information. Remember, a big part of our study is to have fun, experiment, and learn. 😊

## **Intermediate Information:**

### **Enemies vs. Friends**

Enemies are creatures or people that attack you. When you click on them, they will have a yellow or red circle around them, or a yellow or red portrait. A friendly creature or person will have a blue or green circle around them, or a blue or green portrait. Enemies with yellow circles are passive, and will only fight you if you attack them first. Enemies with red circles are hostile and will attack you if you get too close to them, even if you don't want to fight them. Friendly creatures or other players will not hurt you.

#### Summary:

- Blue and Green denotes a friendly creature.
- Red and Yellow denotes an enemy creature.
- Red will attack you if you get too close!
- Yellow is passive and will only fight back if you attack them first.
- If you wish to interact with an enemy, friend or object, right click over them. Right clicking an enemy will attack, while right clicking a friend will talk to him or her.
- Left click selects something for you to view.
- Right click will cause your character to interact with that person or object, if they are in range to do so.
- When you place your mouse over something, your mouse will change to something else if you are able to interact (for example, a speech bubble means you can talk to them, or a sword means you can attack them).

### **Non-Player Characters**

A Non-Player-Character (NPC) is a friendly person or creature that is not controlled by another person. They are computer generated by the game. They

may do things such as give quests, sell or buy items, or can point you in the direction of where to go, or they might not do anything at all!

To talk to a one of these people, put your mouse cursor over them and right click. An NPC with a yellow "!" over their head means they have a quest for you. A yellow "?" over their head means you have completed a quest and you can receive your reward by talking to them and pressing "complete quest." A gray "!" over their head means they will have a quest for you when you get stronger. Finally, a gray "?" over their head means they are waiting for you to complete a quest.

Summary:

- NPCs are friendly, but are not controlled by other people.
- To talk to an NPC, right click on them.
- Some NPCs give quests.

### **Levels and Experience**

When you complete a quest or defeat an enemy you will gain experience (often abbreviated "XP"). This will display in **purple numbers over your character** when you receive more experience. After you gain a certain amount of experience, you will gain a "level," which will increase the overall power of your character. Furthermore, enemies also have levels, which indicate their relative strength. The level is displayed on their portrait. Try to match yourself against enemies that have the same level as you. The enemy's level will also have a color. If the number is green, that means the enemy is a much smaller level than you, and most likely easy to defeat. A gray number means it is extremely weak compared to you, and you will not gain experience from defeating it. A yellow number means it is about as strong as you. An orange or red number means it is a higher level than you and is very difficult to defeat. Finally an enemy marked with a "???" means it is much stronger for your character and should not be fought.

Summary:

- Experience is gained from completing quests and defeating enemies.
- You cannot lose experience.
- You can see the enemy's level on their portrait on the upper left hand



corner.

- If enemies are too strong for you to fight, run away until you get stronger.
- If you encounter "???" enemies, you are most likely in a place that is too much for your character to handle, try going backwards and seeing if you took a wrong path!

## **Learning New Spells**

Every even-numbered level you can learn new spells and abilities! To learn new spells, visit your local trainer. He or she will teach you new abilities at the cost of some money. All new spells can be found in the Spell Book tab (shortcut: press "P"). If they are more powerful versions of your previous spells, they will automatically replace the current version. To place new spells on your screen, press "P" and pull the new spell in any slot you want on the right side of the screen.

- Your trainer teaches you new spells every even numbered level. (e.g.: Level 2, 4, 6)
- Your Spellbook lists all your spells.

## **Chatting with Other Players in the Study**

In order to talk in your environment, hit the Enter key, this brings up a chat box where you can type out a message. After you finish writing your message, hit enter again to send it. Your character can talk in several different methods. They are: Say, Yell, Whisper and Party. "Say" will talk to characters in your immediate vicinity. This is useful for talking to nearby people and is displayed in white text. "Yell" is a slightly extended version of "Say" and will talk to characters in a larger radius in red text. "Whisper" sends a message to a person regardless of their distance, and no one but that person can see the message. Finally, "Party" chat talks to your entire party, regardless of their distance, but only your present party can see what you type, and is displayed in blue text.

Summary of how to Chat:

- "Say" talks to nearby players. It is displayed in white text.
- "Yell" talks to near and far players. It is displayed in red text.

- "Whisper" talks to an individual player regardless of their distance. It is displayed in purple text.
- "Party" talks to your party, regardless of distance. It is displayed in blue text.
- Chatting Continued - In order to use the chat commands you have to type in a chat command. For instance, if you wish to speak in "say" chat, type /s before your message. This will make your character talk in "say" chat until you wish them to speak in a different way. Whispers are a little more complex. You must type /w and then the person's name. For

instance, if you wish to talk to your friend whose name is Billo, type in /w Billo.

- Say's command is /s
- Yell's command is /y
- Whisper's command is /w name
- Party's command is /p

### **Bufs/Debufs**

A buff is a beneficial effect that is placed on your character that makes him or her stronger. Debufs are negative effects placed on your character that weaken him or her. Friendly players can only put buffs on you, while enemies are only capable of putting debuffs on you. If you are given a buff, it will appear on the upper-right hand corner, while a debuff will be placed on the row below that. Both buffs and debuffs wear off after some time has passed. The duration that a buff or debuff lasts is directly under the picture of the buff or debuff. H stands for hours, M stands for minutes and S stands for seconds. If a spell is about to wear off, it will fade in and out, alerting you it will go away.

Summary of "bufs" and "debufs":

- Bufs are good. Debufs are bad.
- Bufs and Debufs are labeled on the upper right-hand corner. Also, you can mouse over them for a more in-depth description.
- Bufs and Debufs do not last forever (with a few exceptions), they will go away after the timer under them runs out.
- To cast a buff on yourself or a friend, simply click the ability and it will place the buff on.
- Some of your abilities put debuffs on the enemies. Debufs can weaken

your enemy tremendously. You can see the debuff on the target if you look at its portrait in the upper left hand corner.

- Some debuffs are possible to remove if you have an item or ability that can remove them.

## **Inventory**

Your inventory is a bag in which you can hold a number of items inside. An item can be anything from food, to weapons and armor, to junk such as wolf teeth. Your inventory is found on the bottom right of the screen. Press the B key to open it. Your inventory has a limited space and can fill up if you have too many things. If your bags are full, you have two options. You can either remove the item from your bag by dragging it out of the bag and onto the screen

and clicking anywhere on the screen. The game will prompt if you want to 'destroy' the item, and then click yes. The other option is selling items to a Non-Player Character. To sell an item, talk to a person that sells items to you, and then right click on the item you wish to sell to him.

Summary of Inventory:

- The inventory holds all of your items.
- Hit "B" to bring up your bag that has all the items in it.
- Delete items by dragging it onto the screen and left-clicking.
- Sell items by right clicking while you are talking to an NPC that buys items.

## **Items**

Some items in your inventory may be for specific quests, for instance if someone asks you to bring them something. These items will be labeled "Quest Items" when you place your mouse over them. Other items can be used by your character, such as food or water. You can place food and water on a button on the right side of the screen for easier access. If you are ever unsure of what an item does, just mouse over it and it will give a description.

## **Equipment**

Sometimes you can find new weapons and armor from quest rewards, off of enemies, or from a person that sells weapons or armor. You can tell if an item is a piece of equipment if you mouse over it and it says which body part it goes

over. For instance, a robe may have the word "Chest" under it, or gloves may have the word "Hands" over it.

If you are unable to use an item for any reason, it will be highlighted in red. If you mouse over it, you will see why it cannot be used. Some weapons or armor you cannot put on because your character doesn't know how to use it. If you are able to put it on, it can be right clicked to automatically switch out whatever you're wearing with that item. Alternatively, it can be dragged over the correct item slot and placed on your character.

Items have particular spots they go on, for instance, boots are placed on the feet, and not anywhere else. There are a number of different item slots, simply mouse over them to see a short description of what they are.

## **Vendors**

There are a number of NPCs which will give you the option to purchase or sell equipment and items. These are called vendors. You will know they are vendors when you mouse over them and your cursor turns into a money bag. Right clicking these vendors opens up a window that allows you to sell and purchase items. To sell an item, right click the item in your bag. To buy an item, right click the item on the vendor's tab. You can browse the vendor's goods by using the arrows on the bottom. If a vendor sells equipment, mousing over the weapon or armor will also cause your currently equipped item to be displayed side-by-side for ease of comparison.

Summary of Selling your Items:

- Vendors sell and buy items.
- Right click an item to sell or purchase it.

The next section is advanced information. This information may be valuable as you progress in the game, but don't worry about understanding it immediately! We just want to make sure information is here for you if you want to read it.

### **Advanced Information:**

#### **Parties (Creating Groups of Players)**

If you wish to adventure together with a friend, you can join a party. To do this, right click their portrait and click "invite to party" or if they ask you first, accept their party invitation that appears on the screen. When in a party with someone, you can more easily talk to them, as well as more easily find them and fight alongside them. When in a party with someone, if you defeat an opponent you both will get credit for defeating it, and both of you will gain experience. Note that while in a party, you take turns in your ability to loot enemies. If you have two people in a party, for instance, you will loot every other enemy. For three people it's every third enemy, etc. You can have up to 5 people in a party. Also note that your experience for defeating an enemy is split between your party, meaning an enemy that normally rewards 100 experience will give 50 experience to you in a party of two. Money looted in this way is also divided. Note that you can heal your party members or give them buffs by clicking on them and using your abilities.

#### **Summary of Forming Groups with other Players**

- Parties are formed to defeat stronger enemies or to have a more enjoyable experience.
- Right click a person's portrait and invite them to your group! This only works on human players like yourself.
- You can have up to 4 other people in a party, for a total of 5.
- You can't invite people to your group if you are not the group leader.
- The group leader has a crown over his or her head on the left side of the screen.
- Money and experience is divided evenly amongst nearby party members.

#### **Currency**

After completing a quest, selling an item, or defeating certain enemies, you will get some money. Money is divided up into three categories, copper, silver and gold. 100 copper equals 1 silver, while 100 silver equals 1 gold. You can view

how much money you have by looking in your bag. The best way of earning money is by doing quests and by selling things to vendors.

### **Damage Types**

While fighting, there are two different types of damage: Physical Damage and Magic Damage. Physical damage comes from your weapons, while magic damage comes from your spells. Most of your abilities cause magic damage. Spells damage is split into different categories: Holy, Shadow, Fire, Ice, Nature and Arcane. You don't need to learn the differences, but if you see something say "Holy Damage" it means it is magic damage. **Damage Details**

When you attack, a number of things has a chance to happen. There is a set chance you will cause double the damage to the target, which is called a critical hit. There is a chance for you to not make contact with the enemy, this is called a miss. There is also a chance the enemy will 'dodge' or 'parry' the attack, which also makes you not damage the target. Note that spells can not be dodged or parried, they can only miss their target. As well as your enemy being able to dodge or parry, you are also able to do the same. When you dodge or parry you will not receive any damage.

- Critical Hits cause twice as much damage as a normal hit.
- A miss, dodge or parry will stop physical damage from occurring.
- Spells cannot be dodged or parried.
- This is all automatic; you do not have to do anything for these effects to occur.
- White numbers indicate physical damage.
- Yellow numbers indicate damage from spells or abilities.

### **Healing**

As opposed to damage, your character can also heal him or herself. Healing is the opposite of damage in that if damage makes your health goes down, healing makes your health go up. Healing will occur when you are not fighting, when you are eating, or if you use a spell that heals you. Healing will appear in green numbers over your character. Also, when you increase your level, your character will be fully healed automatically.

### **Adding Friends**

If you enjoyed playing with someone or you are friends with someone, you can

make them your friend, which makes it easier to communicate with them and see when they are online. To do this, go to your Social Tab on the top of the screen (indicated by a speech bubble) and go to the Friends tab. Click add friend and add his or her character name. From now on the game will tell you if that character logs in.

How to Add a Friend:

- To add a friend, go to your social tab or hit "O".
- Click "add friend" and type in the name of the character you wish to add.
- You can now see if that person is online!

### **Weapon Value**

Some weapons are better than others. In order to determine which weapon is stronger, mouse over each. The first thing you should look for is how much Damage per Second (DPS) a weapon does. The higher this number, the better.

Another thing to look for is if the weapon is one-handed or two-handed. A one handed weapon may not do as much damage, but you can use a shield in the other hand. A two handed weapon requires both your hands so you can't use a shield.

Summary for Choosing Weapons:

- DPS stands for Damage per Second. The higher the DPS, the more damage it does.
- Better weapons have higher DPS.
- One Handed weapons allow you to use a shield in the other hand.
- Two Handed weapons take up both hands.
- Mouse over a weapon to get more information about what the weapon's DPS or if it is one or two handed.

### **Armor Value**

Some armor is better than others. To judge whether something is better, drag your mouse over each item. For armor, you should look for how much armor it gives. The more armor an item has the better. Next armor will say what type of armor it is. The three types of armor are Cloth, Leather and Mail. Cloth is the weakest, while Leather is of medium strength, and Mail is very durable. You can put on the durable Mail armor, which offers your character a lot of

protection. Your character can also use shields, which protects your character from attacks. Better armor has more armor on it.

- Armor comes in three varieties: Cloth, Leather and Mail.
- Mail is the strongest armor.
- Mouse over armor to get more information about what article of clothing it is and how much armor it has on it.