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What Factors Predict Falls in Cognitively Impaired Older Adults?

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COGNITIVELY IMPAIRED OLDER ADULTS?

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ABSTRACT

A significant amount of research has been conducted to identify possible risk factors and causes of falls in older adults as well as implementing interventions in efforts to reduce the incidence of falls in this population. Falls accounted for 2 million non-fatal injuries to adults over the age of 65 in 2007 while over \$19 billion is spent annually on direct medical costs. Most of the literature is representative of healthy, community-dwelling adults while a much smaller amount is reserved for the subpopulation of older adults with cognitive impairment. Cognitively impaired adults are twice as likely to fall as healthy older adults. There are several theories that attempt to explain this increased risk including decreased executive function, decreased visual attention, difficulty with dual-task resource allocation, fear of falling and reduced awareness of deficits. The current study examined these theories directly by having cognitively impaired older adults (N=55) complete a cognitive assessment (Mini-Mental State Examination, clock-drawing test, serial 3-retro, categorical naming task and counting dots) as well as using a dual-task paradigm to assess resource allocation using the 10-meter walk test. Awareness of deficits was measured using a modified version of the Anosognosia Questionnaire-Dementia while fear of falling was assessed using the Short Falls Efficacy Scale-International. The number of falls incurred over the last 12 months was used as the criterion variable. Bivariate correlation and multiple linear regression analyses were conducted to identify significant independent predictors of falls as well as the most

parsimonious model of predictors in this population of cognitively impaired older adults. No significant relationships were found between falls and the predictor variables of working memory, verbal fluency, visual attention, gait velocity, and awareness of deficits. Dual-task cost was not predictive of falls in this sample. Visual attention measured in the single condition was found to be significantly different between single fallers and recurrent fallers. More research is needed to further evaluate this possible relationship as well as continue search for possible unique identifiers of falls in the cognitively impaired older adult in efforts to identify areas amenable to interventions. Possible directions of future research are discussed.

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CHAPTER I

INTRODUCTION

Falls pose an increased threat and risk for injury in older adults. In 2007, the Center for Disease Control reported falls as the leading cause of unintentional injury in adults 65 years and older with over 18,000 resultant deaths. Falls also accounted for 2 million non-fatal injuries and over 500,000 hospitalizations in this population of adults (CDC WISQARS, 2010). While only 5% of the older adult population resides in nursing home facilities nationwide, 20% of recorded falls occur in this environment. It is estimated that the mean rate of annual falls in the nursing home environment is approximately 1.5 falls/bed, which is more than triple the incidence of 1 in 3 occurring in community-dwelling older adults (Rubenstein et al., 1994).

Falls impact more than just the individual. Over $19 billion is spent annually on direct medical costs of the > 2 million non-fatal injuries related to falls in older adults 65 years and older (Stevens et al., 2006). Direct costs include hospitalization and nursing home stays, physician fees, rehabilitative services, home health care, durable medical

equipment, prescriptions, insurance fees and environmental modifications to the home, while indirect costs may incorporate disability, lost work time and changes to quality of life which are often difficult to calculate. Costs per fall to Medicare can range from $9,113 to $13,507 (Shumway-Cook et al., 2009). Englander and colleagues (1996) predict that direct and indirect costs of falls in older adults will increase to over $32 billion by 2020.

A significant amount of research by physical therapists, psychologists, nurses, and other disciplines interested in the aging population has been completed in the past several years in efforts to identify risk factors, causes, and potential interventions in order to reduce falls in the elderly. Most studies found motor impairments (including muscle weakness, balance deficits, and gait instability) (Shaw, 2007; Rubenstein et al., 1994; Rubenstein, 2006; Harlein et al., 2009; Moylan & Binder, 2007; Vassallo et al., 2009; Tinetti et al., 1988; AGS et al., 2001), history of falls (Harlein et al., 2009; Toba, 2008; Asada et al., 1996; Moylan & Binder 2007; AGS et al., 2001), and fear of falling (Delbaere et al., 2010; Boyd & Stevens, 2009; Jung 2008) as common risk factors and causes of falling in community-dwelling older adults. Other authors name medication interactions (Shaw, 2007; Allan et al., 2009; Eriksson et al., 2008; Tinetti et al., 1988; Harlein et al., 2009; Moylan & Binder, 2007), vertigo (Rubenstein, 1994; Rubenstein et al., 2006), syncope (Shaw, 2007; Rubenstein, 1994; Rubenstein et al., 2006; Moylan & Binder, 2007), and other medical conditions including orthostatic hypotension (Rubenstein et al., 1994; Rubenstein, 2006, Eriksson et al., 2008) as high contributors to falls in this population. Many studies also have identified cognitive impairment and confusion (Rubenstein, 1994; Rubenstein et al., 2006; Allan et al., 2009; Toba, 2008;

Eriksson et al., 2008; Moylan & Binder 2007; Tinetti et al., 1988; Anstey et al. 2006; AGS et al. 2001) as significant in raising an individual's risk for falling.

Screening of individuals with cognitive impairment may be especially challenging for many clinicians as current fall risk assessment tools may be inappropriate for older adults with cognitive impairment due to complex instructions or multi-step directions as with the commonly used Timed Up & Go Test (Nordin et al., 2006). No significant literature has been conducted on the efficacy or effectiveness of falls interventions specifically designed for the cognitively impaired older adult. Many daily activities require a complex interaction of cognitive and motor sequences that may seem simple, mundane, or even automatic for cognitively intact older adults. It is possible that these seemingly simple everyday tasks overtax these systems in older adults suffering from cognitive impairment resulting in higher risk of falls.

A routine task such as grocery shopping involves motor coordination and executive control for postural stability in gait, working memory for organization of a shopping list while also completing arithmetic calculations of prices as well as visual attention for wayfinding or visual scanning to avoid environmental hazards. Neural substrates must work together to appropriately allocate resources to maintain the necessary control of our bodies and environment during this type of dual-task activity. Another example may be a resident of a nursing home walking down the hall to the dining room. Motor coordination and executive control are again active for postural stability as is visual attention to safely avoid other residents or the housekeeping cart while simultaneously scanning for the dining room. Memory domains also are active if the resident is attempting to recall today's menu or the daily agenda of activities. It may

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be possible that one or more of these systems fail in older adults with cognitive impairment resulting in the higher risk for falls. If current fall risk assessment tools are not adequate in successfully identifying those at higher risk, it is important to determine alternate modes in distinguishing these groups.

Other concerns lay beyond simple motor and cognitive systems into psychological systems, including knowledge of limitations and history or fear of falling. Imagine an individual with dementia forgetting that a walker is now required for safe ambulation at home leading to loss of balance and a fall. Another example is a nursing home resident who underwent hip surgery following a fall and now is limited in the amount of weight allowed on the lower extremity. A cognitively impaired adult with memory deficits along with a poor awareness of deficits may forget this newly imposed limitation and fall when trying to get of bed. This same resident may be so fearful of falling again that reflexive righting reactions are replaced with anxiety and poor coordination resulting in subsequent falls.

Some of these potential explanations have been superficially presented in falls literature including variable cognitive profiles of executive function, working memory, verbal fluency, and visual attention as well as diminished capacity of successful dual-task resource allocation. Concepts of awareness of deficits and fear of falling also have been peripherally linked in the literature as a potential risk for falls in this population. These potential mechanisms for increased incidence of falling in cognitively impaired older adults deserve exploration to possibly establish appropriate assessment tools and interventions for this population of older adults. This current literature has been

primarily completed on cognitively intact older adults or mixed populations and will be discussed further below.

The following sections will outline classic studies (Tinetti et al., 1998; Rubenstein, 1994; Rubenstein et al., 2006) identifying global cognitive impairment as a risk factor for falls in the general population then move into the summary of authors attempting to differentiate cognitively impaired samples of older adults from their intact counterparts (Asada, 1996; Erikkson et al., 2008; Allan et al., 2009). The final section will review literature aimed to identify specific domains or mechanisms responsible for increased incidence of falling although these studies examine older adults without clinical cognitive impairment. No significant research has been conducted to identify specific mechanisms underlying increased incidence specifically in the cognitively impaired older adult (Harlein et al., 2009).

Risk Factors and Causes of Falls in Older Adult Population

Tinetti and associates (1988) examined predictors of falls in 336 community-dwelling older adults. A thorough assessment was conducted at the onset of the study including an interview to assess past medical history, current medications, depression level, level of disability, and any history of alcohol abuse. A nurse-researcher examined each participant on several domains: history of falls, symptoms of dizziness or musculoskeletal disorders, fear of falling, orthostatic hypotension, vision and hearing acuity, screening for foot problems, kinesthetic awareness, balance, and gait stability as well as a home assessment for environmental hazards. Each participant was given a diary to record any falls related activity. Telephone contact was made every other month by researchers to collect this data.

Following one-year of data collection, analysis found that sedative use, cognitive impairment, lower extremity disability, palmomental reflex (primitive reflex that occasionally returns in older adults that may disrupt cortical inhibitory pathways), balance and gait instability, and foot problems should be included in the final model for best prediction of falls in older adults living in the community. The same risk factors were found for single and recurrent fallers, only these risk factors were more strongly correlated in recurrent fallers. Cognitive impairment and sedative use were found in low prevalence but had very high correlation to risk of falls. However, cognitive impairment was measured globally instead of being separated into specific domains such as executive function, attention, or memory components. This type of deconstruction would be more beneficial to clinicians when designing specific assessment tools or interventions. Older adults with severe cognitive impairment (measured as those not able to follow simple commands) were not included in this study; therefore it is feasible that the prevalence was underestimated. The author reported these adults were not included since they were not able to follow commands to all assessments.

Epidemiology and risk factors for falls is discussed as well in meta-analyses by Rubenstein in older adults living in a variety of settings (2006) and nursing home residents (1994). In review of data from 12 large retrospective studies, environmental hazards were the most cited cause of falls in older adults (Rubenstein, 2006). In this same article, 16 controlled studies were summarized to review the most common individual risk factors in relationship to falls. Weakness and balance deficits were found as the most significant risk factors followed by gait problems, visual deficits, cognitive impairment and postural hypotension. These same risk factors were found in the article

summarizing only nursing home residents with the addition of sedating and psychoactive medications (Rubenstein et al., 1994). However, environmental hazards are only the third cause of falls the nursing home setting while the presence of gait or balance disorder or muscle weakness ranks highest.

Some researchers have conducted studies using samples with cognitive impairment in efforts to identify risk factors in this population, but have failed to reach an underlying mechanism to explain this increased prevalence (Asada et al., 1996; Eriksson et al, 2008; Allan et al., 2009). Identifying the underlying mechanism(s) is crucial in this line of inquiry to develop appropriate screening and assessment tools as well as initiating interventions targeted for cognitively impaired older adults. These authors have laid a solid groundwork for future falls research and their efforts will be discussed below.

In all of these studies (Asada et al., 1996; Eriksson et al, 2008; Allan et al., 2009), the authors found support for the notion that cognitive impairment is a significant risk factor for the increased incidence of falls as the group of older adults with cognitive impairment fell significantly more often than the comparison groups. Asada (1996) suggested that demented older adults may be at higher risk for falls if they are more mobile but require more assistance for proper completion of tasks due to decreased initiation of task, inability to independently sequence or follow directions. The other authors (Eriksson et al., 2008; Allan et al., 2008) found the same risk factors in both cognitively impaired and healthy older adults; therefore, these studies may not contribute to the understanding of an underlying mechanism that explains the increased risk in participants with cognitive impairment.

Eriksson and colleagues (2008) also suggested that there may be other factors present that are not commonly studied or that risk factors are less important than circumstances surrounding the fall in demented older adults (Eriksson et al., 2008). Further investigation is needed in this population to determine the answer to this question including specific domains of cognitive processing that may be responsible for this increased risk of falls. This sentiment also is expressed in a systematic review by Härlein et al. (2009). The authors determined that there is a "lack of sound studies examining fall risk factors in cognitively impaired elders." This understanding is vital to the development of assessment tools as well as interventions.

Potential Underlying Cognitive Processes in Older Adults

Some authors report cognitively impaired adults are twice as likely to fall as their cognitively normal counterparts (Tinetti et al. et al. 1988; Eriksson et al., 2008), while others have found this increased risk to be as high as eight-fold (Allan et al., 2009). Some potential conceptualizations that are beginning to emerge in the literature as to this increased risk include decreased executive control which can be broken down further into cognitive processes such as working memory, verbal fluency, and visual attention (Anstey et al., 2006, 2009; Holtzer et al., 2006, 2007; Montero-Odasso et al., 2005; Owsley et al., 2004; Maylor & Wing, 1996); difficulty with dual-task resource allocation (Montero-Odasso et al., 2009; Sheridan et al., 2003; Verghese et al., 2002; Shumway-Cook et al., 2000; Swanenburg et al., 2010; Beauchet et al., 2007; Bootsma-van der Wiel et al., 2003; Hauer et al., 2002, 2003); fear of falling (Maki et al., 1991; Delbaere et al., 2010; Jung, 2008; Boyd & Stevens, 2009); and poor awareness of deficits (anosognosia) (Migliorelli et al., 1995; van Iersel et al., 2006). Few studies directly relate the changes

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or variance in cognitive performance to incidence of falls in older adults (Anstey et al., 2006, 2009; Holtzer et al., 2007). The above studies have provided a solid foundation beginning the investigation into identify specific cognitive processes that should be held responsible for the increased incidence of falls for the cognitively impaired older adult. However, many of them use the general population or community-dwelling older adults without clinical levels of cognitive impairment. It will be important to identify whether these findings are also prevalent in older adults with cognitive impairment. If so, it may assist researchers to further pinpoint the cognitive processes responsible for increased risk of falls in this population. The studies will be discussed further as well as other evidence of the concepts that have been introduced using gait velocity and postural sway in addition to the outcome of falls as a criterion variable. This body of literature is certainly relevant as postural sway and gait velocity have both been found to been significant predictors of falls (Lajoie et al., 2002, 2004; Montero-Odasso et al., 2005).

Some older adults may begin to experience cognitive deficits, usually affecting the domain of memory initially. These older adults do not yet experience significant functional deficits or overt signs of cognitive decline. Approximately 14% of older American's are diagnosed with some type of dementia including Alzheimer's disease if symptoms progress enough to limit abilities in daily tasks such as handling medications, finances, or other typical problem-solving tasks (Plassman et al. 2007). Performance on neuropsychological assessments for executive function including working memory, verbal fluency, and visual attention/processing will typically decline gradually through the continuum from mild cognitive impairment to clinical diagnosis of dementia.

Cognitive performance

Executive function

The role of executive function and cognition on fall prevalence has been studied in adults that do not display clinical levels of cognitive impairment or dementia. Cognitive profiles including reaction time testing differ significantly for fallers and non-fallers in community-dwelling older adults, where single and recurrent fallers demonstrated decreased accuracy and inhibition over non-fallers (Anstey et al. 2006). Higher reaction times, slower visual search (as indicated by scoring on computer version of pen/paper cancellation test), and lower scoring on Trail Making Tests A&B (TMT A&B) also was seen in recurrent falls when compared single and non-fallers. Holtzer et al. (2006, 2007) also studied the cognitive performance in older adults from the Einstein Aging study. These studies revealed that three neuropsychological factors (speed/ executive function, memory, and verbal IQ) accounted for 16% of variance in gait velocity in a single task condition (2006), which has been shown to be a high correlate for falls (Montero-Odasso et al., 2005). Results from another study discovered that a single point (standard deviation) increase in the speed/executive attention normalized factor score (compromised of TMT A&B, block design, digit symbol), indicating better performance, was responsible for 50% reduction in risk of falls in their sample from the Einstein Aging study (Holtzer et al., 2007). In 2009, Montero-Odasso and associates also used the TMT A&B along with Letter Number Sequencing to test executive function and working memory. A significantly negative correlation to these neuropsychological assessments and gait velocity was found in both normal walking and dual-task conditions.

Visual attention

In addition to executive function, other cognitive domains have been held partially accountable for declines in functional performance. Owsley and McGwin (2004) found that lower scores on visual attention using the divided attentions subtask on UFOV (Useful Field of View) test were significantly related to poorer performance in functional mobility as measured by POMA (Performance Oriented Mobility Assessment). Kerr (1985) showed that a balance task disrupted performance on a spatial memory activity in 24 young adults, but did not lower performance on a non-spatial memory task under dual-task conditions. Maylor & Wing (1996) found that out of five cognitive conditions, only the Brook's spatial memory task and backward digit recall revealed age-related differences in postural control during dual-task testing. Visual attention also has been identified by Anstey et al. (2009) as being associated with increased risk of falls in a sample of older adults without evidence of cognitive impairment.

Working memory and Verbal fluency

Working memory has been assessed in numerous studies using a dual-task paradigm (Doumas et al., 2008; Montero-Odasso et al., 2009; Hauer et al. 2002 & 2003; Beauchet et al., 2005). In all five studies, dual-task costs were evident when a working memory load was added to gait or postural stability. Two of these studies (Montero-Odasso et al. 2009; Beauchet et al., 2005) along with Bootsma-van der Wiel and associates (2003) also utilized verbal fluency as a cognitive load in the dual-task condition. Results were rather mixed in these three studies. One study found significant dual-task costs with the verbal fluency condition (Montero-Odasso et al., 2009) while the others did not. However, one group of authors identified verbal fluency in the single-

condition to be a significant predictor of falls in a sample of community-based older adults but did not find the dual-task condition to add any unique predictive value (Bootsma-van der Wiel et al., 2003). When comparing neuropsychological profiles of fallers to nonfallers, Holtzer et al. (2007) discovered the Verbal IQ added incremental variance to Executive Function in predicting falls in healthy older adults, however did not find it as a significant predictor of changes in gait velocity (Holtzer et al., 2006).

This literature provides an excellent groundwork for further research into the relationship of cognitive functioning and falls in older adults. No research known to this author has been conducted using this methodology with a sample of older adults having cognitive impairments or clinical dementia to determine the extent to which specific cognitive domains contribute to falls in this population.

Dual-task resource allocation

During everyday activities, an individual is forced to perform concurrent tasks while moving about the environment such as carry on a conversation, visually scan the area for wayfinding or engage working memory for mental calculations. In older adults, these cognitive functions when added to mobility tasks may overload the resources available creating less ability to react to postural threats such as a wet floor and needing to negotiate around an obstacle. Many researchers have investigated this paradigm using a dual-task methodology which adds a cognitive or manual load to the single task condition of walking or postural stability. Several authors have reported increased gait variability in older adults under dual-task conditions, especially those with decreased cognition (Montero-Odasso et al., 2009; Sheridan et al., 2003; Yogev et al., 2008; Verghese et al., 2002; Shumway-Cook et al., 2000). These findings may indicate

decreased automaticity of gait with aging requiring more executive function and attention during routine functional mobility tasks. The dual-task literature is difficult to compare and analyze compositely due to differing methodology, samples and statistical analysis (Zijlstra et al., 2008; Frazier & Mitra 2008). Many authors compare healthy younger adults with community-dwelling adults without cognitive impairments (Bock, 2008; Doumas et al., 2008; Hauer et al., 2002 & 2003; Li et al., 2001) while others examine differences between community-dwelling adults that have history of falls and those who do not (Swanenburg et al., 2010; Beauchet et al., 2007; Bootsma-van der Wiel et al., 2003; Hauer et al., 2002 & 2003; Verghese et al., 2002; Shumway-Cook et al., 2000; Lundin-Ollson et al., 1997). Some authors investigate older adults with cognitive impairments (Montero-Odasso et al., 2009; Hauer et al., 2002 & 2003), however significant differences still exist in outcome measures and methodology. Some literature assesses postural sway as the motor component of the dual-task comparison using the Balance Master (NeuroCom[®], a division of Natus[®]) or a force plate. Gait velocity and stride patterns as an outcome measure is often seen in dual-task literature, which as stated earlier have been linked as significant predictors of falls (Montero-Odasso et al. 2005).

Although it is difficult to compare the literature directly, some trends have emerged that are interpretable to assist clinicians and direct future researchers. Generally, a decrease in gait velocity or postural stability is noted during a dual-task activity in older adults when compared to younger adults and also in older adults fallers versus non-fallers (Verghese et al, 2002; Doumas et al., 2008; Hauer et al., 2003; Bootsma van-der Wiel et al., 2003; Swanenburg et al., 2010; Montero-Odasso et al.,

2009; Shumway-Cook et al., 2000).   This decrement most often becomes more pronounced when a more complex cognitive task is attempted.

Fear of falling

Fear of falling is an important psychological factor that may be associated with falls (Maki et al., 1991; Delbaere et al., 2010). Various estimates have been cited in the literature as to the prevalence of older adults with a fear of falling. In a comprehensive review, Jung (2008) reports that between 40-73% of older adults that reported falls also report a fear of falling while Boyd and Stevens (2009) found 36.2% of respondents expressed a moderate to severe fear of falling. Fear of falling may be separated into actual physiological risk resulting in the fear or a potentially irrational psychological fear or perceived risk that may result in self-limiting activity or overcompensation. Exploration of these different components of an overall fear of falling (during a 1-year prospective measurement of falls) revealed older adults with a low physiological risk but high perceived risk fell more often than older adults with high physiological risk and low perceived risk (Delbaere et al., 2010). This strong psychological contribution to fear of falling warrants its inclusion in any study regarding falls in older adults.

Awareness of Deficits

Poor awareness of deficits, often referred to as anosognosia, may lead a person to overestimate their capabilities and potentially participate in unsafe activities. It is suggested that adults with cognitive impairment may use this degree of denial as a protective defense mechanism against symptoms of depression (Migliorelli et al., 1995). Theoretically, this lack of insight may contribute to falls in older adults that display lower levels of insight into their deficits and limitations. While no studies were found that

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directly link anosognosia to increased risk of falls, gait velocity has been assessed with in patients with dementia. It was predicted that gait velocity would be slower in patients with dementia as decreased gait velocity is often correlated with increased falls, however the opposite scenario was discovered (van Iersel et al., 2006). Mean gait velocity for patients with dementia was found to be slower than without dementia as predicted, but when controlled for parkinsonism, use of walking aids and ADL functioning, demented patients walked relatively faster than those without dementia. Possible explanations may include decreased inhibition or recklessness due to damage in frontal cortex. Also, decreased insight and subsequent lack of behavior modification to improve safety may lead to this relative increase in gait velocity.

The role of executive function including working memory, verbal fluency, and visual attention in both single task and dual-task conditions along with fear of falling and unawareness of limitations are a few possibilities that may explain reasons that cognitively impaired individuals have a higher risk of falling than healthy older adults. These mechanisms certainly warrant further study directly in this population in attempts to explain which of these variables, if any, contribute to increased likelihood of falls. In a meta-analysis reviewing strategies to prevent falls in care homes and inpatient hospitals, Oliver et al. (2008) noted out of 43 included studies that only one study exclusively examined a population of older adults with cognitive impairment. A systematic review completed by Härlein and associates (2009) also concluded that there is a lack of solid research examining cognitively impaired adults with respect to fall risk factors. This demonstrates that very little has been done to research this group of older adults.   There is no current literature identifying modifiable risk factors for falls in the cognitively

impaired older adult. There are also no studies known to this author of positive interventions in the reduction of falls in this population.

The current study examined falls as a direct outcome measure in a sample of cognitively impaired older adults in efforts to better identify risk factors that may be unique to this group of individuals. This line of inquiry is vital to developing relevant assessment tools and possible interventions in this difficult group of fallers. It was hypothesized that gait velocity in single and dual-task conditions, poor performance on certain cognitive assessment tasks (working memory, verbal fluency, and visual attention) and poor awareness of deficits will independently predict an increased risk of falls in cognitively impaired older adults.

Hypotheses:

Main Effects Hypotheses
Hypothesis #1
A negative correlation was predicted for each of the following independent variables: gait velocity, working memory, visual attention, verbal fluency, awareness of deficits; and the dependent variable: falls.

Dual-tasking Hypotheses
Hypothesis #2
Poorer performance in dual-task conditions (dual-task decrements) measuring gait velocity, working memory, verbal fluency, and visual attention was predicted to correlate positively with falls in older adults with cognitive impairment.

Individual Differences Hypothesis
Hypothesis #3
Binomial & multinomial sequential logistic regression will identify the most parsimonious group of predictor variables in identifying cognitively impaired older adults at higher risk of falls. It is predicted that dual-task working memory and visual attention will be the unique and significant cognitive predictors of falls in the cognitively impaired older adult while anosognosia will add significance as an individual difference measure to this model.

CHAPTER II

METHODS

Measures

Demographic and Health Information

Demographic information including age, gender, marital status, and number of medications was obtained from medical records by researcher. Participants were asked to rate their overall health on a 4-point Likert scale (poor, fair, good, excellent), as well as provide highest level of education completed.

Cognitive Assessment

Participants completed several cognitive measures to assess general level of cognitive status, executive function, working memory, verbal fluency, visual attention, and spatial perception capacities. The Mini-Mental State Examination (MMSE) (Folstein et al., 1975) and a clock-drawing test (Juby et al., 2002; Watson et al., 1993) were used to assess general cognitive function and utilized for inclusion and exclusion criteria.

Mini-Mental State Examination

The MMSE is a formalized mental status examination that simply and quickly assesses a restricted set of cognitive functions (working memory, language & praxis, orientation, memory and attention), taking the examiner about five to ten minutes. MMSE performance predicts important functional outcomes such as medication adherence, length of rehabilitative needs and outcomes (Lezak, 2004). A score of less than 24 out of 30 possible points is considered abnormal. Test-retest reliability of the MMSE is high at 0.89 for intratester reliability and 0.83 for inter-tester reliability (Folstein et al., 1975). As stated earlier, if the MMSE had been administered within the past 3 months by a licensed speech-language pathologist (SLP), this score was utilized (Clark et al., 1999; van Belle et al., 1990). However, if not, informed consent was obtained by the researcher to administer the MMSE as screening tool for inclusion in the current study.

Clock drawing test

In addition to the MMSE, a clock-drawing test was used as an additional measure for global cognitive function, as it has been found to enhance the evaluation by assessing domains of cognition not examined by the MMSE alone (Juby et al., 2002). People with executive cognitive dysfunction can have a normal score on the MMSE but still have severe functional limitations. The clock-drawing test (Watson et al., 1993) demonstrates test-retest reliability of 0.76 and inter-rater reliability of 0.90 to 0.93. It is a moderately sensitive and specific tool can identify cognitive dysfunction when use as an adjunct to the MMSE (Juby et al., 2002). Juby and associates (2002) found a sensitivity of 59% and

specificity of 70% for detecting executive cognitive dysfunction in participants scoring normal on the MMSE when using the Watson method of scoring (Watson et al., 1993).

Each participant was given a pre-drawn circle and be asked to "place the numbers on it to make it look like a clock." They were asked to draw hands on the clock to read "10 past 11". The scoring method described by Watson and colleagues (1993) was used by dividing the clock into four quadrants (see appendix A). The score was determined from the number of digits in each quadrant (0-3 = normal; 4-7 = abnormal). See Table I for sample scoring on MMSE and CDT test.

Serial 3-retro calculation

Working memory tests assess how individuals are able to hold and manipulate information. Arithmetic calculations were used for assessment of working memory. The participant was asked to count backwards by three's (serial 3-retro) starting from 50, 70, or 100. During the single task condition (sitting), the test was timed for 30 seconds while during the dual-task condition (while walking), it was timed for the duration of the 10-meter walk test. (The dual-task protocol is described in depth in a later section.) This task was scored based on number of calculations correct per minute so that comparisons could be made as needed between the single and dual-task conditions. Higher scores represented better performance than lower scores.

Categorical naming task

Word fluency tests can provide good assessment of how participants organize thought and reductions in fluency may occur in patients with diffuse brain injury (Lezak, 2004). Verbal fluency was measured using a categorical naming task in which each participant was asked to name as many items as possible with the categories of animals,

fruit, or occupation (Montero-Odasso et al., 2009; Bootsma-van der Wiel et al., 2003; Beauchet et al., 2005). Scoring was calculated in the same manner as with the serial-3 retro task. In the single task condition (sitting), the participant named as many items as possible in 30 seconds, while timed for the duration of the 10-meter walk test during the dual-task condition which is described in a later section. The number of responses correct was calculated into words per minute in order to allow comparison under the dual-task condition. Higher scores indicated higher performance on the task.

Counting dots

Deficits in visual scanning have been associated with accident-prone behavior (Lezak, 2004). Counting dots, which is a visual scanning task, was used to measure visual attention (Lezak, 2004). Difficulties with this task may be due to visual inattention, difficulty maintaining an orderly approach to the task, or tracking problems. For the current study, a projector was used to display a pattern of dots on a screen in front the participant. The subject was asked to identify the numbers of dots located on the screen and their response was recorded. Regardless of whether the answer was correct, the screen was immediately updated with a new pattern of dots for the participant to count. This procedure was repeated and continued for a period of 30 seconds in the single condition and for the duration of the 10-meter walk test during the dual-task condition. Scoring was completed using the number of correct responses per minute. Higher number of correct responses per minute indicated higher performance.

Modified Anosognosia Questionnaire-Dementia

Participants completed a modified version of the Anosognosia Questionnaire-Dementia (modified AQ-D) (see Appendix B). The original version of the AQ-D has

been found to be both valid (Cronbach's alpha 0.91) and reliable (r=0.90) (Migliorelli et al., 1995). This instrument is divided into two sections and totals 26 questions. The first section assesses intellectual functioning while the second section examines behaviors, such as interests and personality characteristics. Each question was rated by the participant on a scale from 0 (never) to 3 (always). A higher score indicates more impairment. In the original format, Form A is answered by the participant alone while Form B is answered by the caregiver separately from the participant and blind from the participant's answers. Final scoring in the original AQ-D is completed by subtracting scores of the caregiver from those of the participant. Negative scoring indicates the caregiver rated the participant as more impaired, while a positive score indicates the participant perceives more impairment than the caregiver.

Alzheimer's patients with anosognosia are shown to have significantly lower MMSE scores than those without anosognosia (Migliorelli et al., 1995) indicating a possible correlation between global cognitive status and awareness of deficits. In the current study, the AQ-D was modified to be more congruent with the activities completed in a residential nursing facility. Scoring consisted of scoring from 0 to 3 per item with higher scores indicating more perceived difficulties. One form (Form A) of the modified AD-Q was completed by the participant while another form (Form B) was completed by the caregiver most familiar with the participant's daily performance and capabilities (family member, nursing staff member, therapist). Psychometric analysis of the modified AQ-D was completed to ensure appropriate levels of reliability prior to statistical analysis. Ipsative mean substitution was used to replace missing answers in Section A and Section B of the modified AQ-D to ensure all respondents were included in reliability

analysis. Cronbach's alpha (participant form=.81, CG form=.90) indicated good reliability with this sample of cognitively impaired older adults and CGs.

The questions were verbally read to the participant by the researcher while a response card with the possible responses of "never", "sometimes", "often", or "always" was placed in front of the participant. The caregiver completed the form independently. The caregiver was blind to the participant's answers prior to completion of Form B. Each form was scored then a final score is obtained by subtracting the scores on Form B from those on Form A (Form A – Form B). Negative scores indicate that the caregiver scored the participant as more impaired than the participant's self-evaluation suggesting a lack of insight into deficits (Migliorelli et al., 1995).

Short Falls Efficacy-International (FES-I)

The Short Falls Efficacy Scale – International (Short FES-I) was used to assess fear of falling in the current study (see Appendix C). The Short FES-I contains 7 items from the original FES-I (items 2,4,6,7,9,15 and 16) and has been found valid and reliable (Cronbach's alpha 0.92, intra-class coefficient 0.83) in comparison to the FES-I (Kempen et al., 2008). The original FES-I has been found valid in measuring the fear of falling in older adults with cognitive impairment (Hauer et al., 2011), while correlation of the Short FES-I to the FES-I is strong at 0.97 (Kempen et al., 2008). Hauer and associates (2011) also found excellent validity of the short FES-I with cognitively impaired individuals.

Scoring for Short FES-I is described by Kempen and associates (2008) as follows:

> "Each of the 7 items is scored from "0" (not at all concerned) to "4" (very concerned). To obtain a total score for the Short FES-I simply add the scores on all the items together, to give a total that will range from 7 (no concern about falling) to 28 (severe concern about falling)." (Kempen et al., 2008).

Psychometric analysis also was completed on the FES-I to ensure appropriate levels of reliability prior to statistical analysis. Ipsative mean substitution was used to replace missing answers to ensure all respondents were included in reliability analysis. Cronbach's alpha of .88 indicated good reliability with this sample of cognitively impaired older adults.

Assessment of Gait Velocity

10-meter walk test

Gait velocity was measured using the 10-meter walk test (Steffen et al., 2002). Many studies use the Timed Up and Go, which strongly predicts incidence of falls in healthy, community-dwelling older adults (Shumway-Cook et al., 2000; Kristensen et al., 2007; Whitney et al., 2005). This assessment tool was inappropriate to use in the current project due to the population of cognitively impaired adults and dual-task methodology. It has been demonstrated that although level of variability in performance was not related to cognitive performance, verbal cuing was required in over 60% of trials even after 2 sessions of practice (Nordin et al., 2006). This cuing, needed due to the multiple step direction required in the TUG, can significantly skew results and would make it difficult to load a cognitive task for dual-task conditions. Gait velocity is also a significant and independent predictor of declining health including hospitalizations, increased dependence on caregivers, and new falls in older adults (Montero-Odasso et al., 2005).

Administration of the 10-meter walk test requires very little space and equipment allowing ease of completion in virtually any clinical or research setting. The test is comprised of a single step direction "walk at a comfortable pace to the end of the course" which will be less confusing for older adults with cognitive impairment, thus allowing

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less confounds during dual-task conditions. Using a population of patient with varying levels of neurological impairment, the test/re-test reliability of the 10-meter walk test was found to be 0.93 (Rossier et al., 2001).

The 10-meter (33 feet) walkway was taped off for the measurement portion of gait velocity while only the center 6 meters is timed, (see Figure 1) to account for acceleration and deceleration. The participant was asked to walk at their normal pace to the end of the walkway or to a chair. Timing was initiated when the participant crosses the 2-meter line and was terminated after 6-meters of walking at the 8-meter line. The mean of 3 trials was used as the single condition gait velocity (GV) measure.

| 0m | 2m | | 8m | 10m |
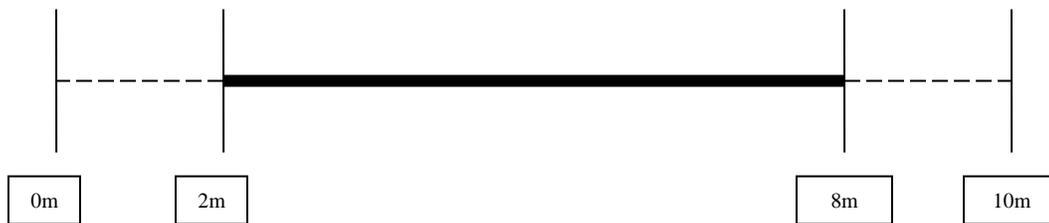
Figure 1. – layout of 10-meter walk test: the bold line indicates timed portion of test, while dotted lines indicate areas of acceleration and deceleration that are not timed.

Dual-task resource allocation

Serial 3-retro calculation while walking

The participants were asked to count backwards by three's (serial 3-retro) starting from 50, 70 or 100 while walking as described in the 10-meter walk test. It was timed for the duration of the 10-meter walk test and was scored based on number of calculations correct per minute so that comparisons could be made as needed between the single and dual-task conditions. Higher scores represented better performance than lower scores.

Performance in both gait velocity and mental calculations were compared to performance in the single task condition to determine the amount of dual-task cost.

Categorical naming task while walking

Verbal fluency was measured using a categorical naming task in which each participant was asked to name as many items as possible with the categories of animals, fruit or occupation while walking as described in the 10-meter walk test (Montero-Odasso et al., 2009; Bootsma-van der Wiel et al., 2003; Beauchet et al., 2005). The number of responses correct was calculated into words per minute in order to allow comparison under the dual-task condition. Higher scores indicated higher performance on the task. Performance in both gait velocity and categorical naming task were compared to performance in the single task condition to determine the amount of dual-task cost.

Counting dots while walking

The subject was asked to identify the numbers of dots located on a screen on the wall in front of them while walking as described in the 10-meter walk test. Scoring was completed using the number of correct responses per minute. Higher number of correct responses per minute indicated higher performance. Performance in both gait velocity and counting dots were compared to performance in the single task condition to determine the amount of dual-task cost.

Outcomes

A 12-month retrospective review of falls was used as outcome measure in the current project. Falls were defined as "a person descending abruptly due to the force of gravity and striking a surface at the same or lower level" (CDC, 2011). In a recent

review, Ganz and associates (2005) reported that recall of falls from 12-months prior was specific (91-95% specificity) but less sensitive (80-89% sensitivity) than the criterion standard of prospective collection such as calendars and postcards. This specificity and sensitivity demonstrated that retrospective collection of falls data is an acceptable method of obtaining outcomes data in the current study. They also reported that participants demonstrated poorer recall for 3 or 6 months prior than in the previous 12 months (Ganz et al., 2005).

Since individuals with poorer cognitive function are less likely to recall falls leading to possible underestimation (Ganz et al., 2005), falls data were be obtained through the review of available medical records as well as reviewed verbally from participants to maximize inclusion of all pertinent information regarding previous 12-month period. A complete record of falls was provided by the facility for each participant encompassing the past 12-month period from date of assessment. This record was reviewed with the participant to ensure that all falls were included in the outcome data. If the participant identified additional falls that were not recorded by the facility, the information was added to the data. The data was dichotomized into non-fallers (zero or 1 fall: Swanenburg et al., 2010) and fallers (more than 1 fall); and trichotomized into non-fallers, single fallers, and recurrent fallers (Anstey et al., 2003; Anstey et al., 2006; Bootsma-van der Wiel et al, 2003). Two categorizations of the outcomes data were utilized in this study to ensure that differences in findings were not solely based on categorical separation.

Participant Screening

The participants in the current study were drawn from patients and residents from a skilled nursing facility and an assisted living facility in Tallmadge, Ohio and Twinsburg, Ohio. The facilities were given a list of all inclusion and exclusion criteria by the researcher as listed below. A preliminary list of potential participants was developed by the facility primarily by restorative nursing and/or an MDS nurse (from nursing, therapy, social work and MDS records) based on this criterion for review. If inclusion or exclusion of a potential participant was unable to be determined from available records or facility staff, informed consent was obtained by the researcher and the screening process was completed.

Inclusion criteria

Inclusion criteria were the age of 55 or older, being able to walk > 10 meters with or without assistive device but without physical assistance, and presence of cognitive impairment. The presence of cognitive impairment was determined if any of the following exist: medical diagnosis of dementia, memory impairment/loss or mild cognitive impairment; score on Mini-Mental State Examination (MMSE) of less than 24/30 (Folstein et al., 1975; Tombaugh & McIntyre, 1992; Dick et al., 1984); or if normal score on MMSE, patient was still considered if a score on clock-drawing test of greater than 4 is exhibited (Juby et al., 2002; Watson et al., 1993). If participant had MMSE administered by licensed SLP within the past 3 months that score was utilized. Otherwise, MMSE was administered by researcher following receipt of informed consent.

Exclusion criteria

Exclusion criteria included presence of the diagnoses Parkinson's disease, brain tumor or traumatic brain injury within the participant's medical records, the inability to complete testing protocol, or score of less than 12/30 on the MMSE indicating moderate to severe cognitive impairment (Bass et al., 2003; Bass & Judge, 2003; Whitlatch et al., 2006; Brod et al., 1999).

Participants provided written informed consent prior to participation in study. If participant had a power of attorney listed in their medical records, that person was contacted by the researcher prior to participation for notification as well as the opportunity to ask questions about the study. This notification was done per the request of the administrators of the supporting sites. If the power of attorney objected to the participant's inclusion in the study, this request was honored by the researcher. This study has been approved by the Cleveland State University Institutional Review Board and administration of Sprenger Health Care Systems, Inc.

Procedure

Following receipt of informed consent from the participant, data was collected in a single session (except for 2 participants that required second session to completed Modified AQ-D and Short FES-I due to dinner being served). A global cognitive assessment was completed using the MMSE and the clock-drawing test. The participant was included in the study for further assessment if less than 24/30 is scored on the MMSE; or a clock drawing test of 4 or greater if the MMSE score is in the normal range. If the participant did not meet the inclusion criteria, they were thanked for their time and escorted back to their room.

If the inclusion criteria were met, further cognitive testing including serial 3-retro calculation, categorical naming, and a counting dots task was completed. The 10-meter walk test was completed to assess gait velocity in a single task condition. The 10-meter walk test also was used during the dual-task conditions along with serial 3-retro calculation, categorical naming and visual attention task. The modified AQ-D and Short FES-I was administered as well. Nine individuals were unable to complete the visual attention portion of the protocol due to visual deficits, one participant was unable to complete the dual-task visual attention due to increasing pain in her foot, and one participant refused to complete any portion of the dual-task paradigm due to self-reported fatigue.

Sixty percent of participants completed the single task conditions (cognitive tests and 10-meter walk test) followed by the dual-task conditions while 40% of participants completed the dual-task conditions first. This counterbalancing of single and dual-task conditions was completed to reduce the bias of fatigue during comparison of these activities. The Modified AQ-D and Short FES-I were administered last in all sessions.

Participants

Initially, 132 individuals were identified by the facilities as possible participants for the current study. Of these 132 older adults, 77 individuals were excluded for participation: nine refused; nine did not meet criteria of cognitive impairment following completion of MMSE and CDT; 27 had diagnosis of traumatic brain injury; one had brain tumor; eight had diagnosis of Parkinson's disease; and 23 individuals were not able to ambulate 10 meters without physical assistant from staff or researcher. These exclusions left a sample of 55 participants in the current study.

As mentioned earlier, the participants (N=55) in the current study were drawn from patients and residents from a skilled nursing facility and an assisted living facility in Tallmadge, Ohio and Twinsburg, Ohio. Some participants resided in the facility while receiving skilled rehabilitation while others were long term care residents (N=27, facility in Tallmadge; N=28, facilities in Twinsburg: N=15 from ALF/ILF, N=13 from skilling nursing and long term care facility). Overall, the sample was predominantly female with a low percentage of college graduates. The sample had an average age of 85 years, exhibited mild to moderate cognitive impairment (MMSE: $\bar{X}$=19.96, SD=3.68) as well as mild to moderately impaired executive function (CDT: $\bar{X}$=5.02, SD=2.42). The current sample averaged taking over eight medications and classified their own health as "fair to good". Participant characteristics are summarized in Table I.

Table I.

Characteristics of Participants (N=55)

Participant Characteristic	Mean	SD
Age (range = 57 – 100 years)	84.8	9.09
MMSE (range = 13 – 28)	19.96	3.68
CDT (range = 0 – 7)	5.02	2.42
Medications	8.13	2.87
Self-rated health	2.65	.93
	%	
Female	71%	
College graduate	9%	

Note. MMSE = Mini Mental State Exam. For MMSE, higher scores indicate higher levels of functioning. CDT = Clock Draw Test. For CDT, higher score indicate higher levels of deficit in executive functioning. For Self-rate Health, 1 = poor, 2 = fair, 3 = good, 4 = excellent.

CHAPTER III

RESULTS

The results section is organized with a summary of necessary performance measures and analyses followed by findings as related to each hypothesis. Summary of participant performance on individual measures is discussed first followed by findings related to Hypothesis #1, which predicted negative correlations between falls and several independent variables (gait velocity, working memory, visual attention, verbal fluency, awareness of deficits). Next, dual-task cost analyses are outlined along with findings related to Hypothesis #2, which hypothesized that poorer performance in dual-task conditions, or high DTC, in gait velocity, working memory, verbal and visual attention would correlate positively with falls in older adults with cognitive impairment.

Third, regression analysis is discussed with relation to Hypothesis #3 which was designed to identify the most parsimonious group of predictor variables of falls in cognitively impaired older adults. Finally, an exploratory analysis was conducted and is reviewed.

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Statistical analysis

Bivariate correlations were used to examine Hypotheses #1 and #2 which attempted to identify significant relationships between the independent variables (working memory, verbal fluency, visual attention, gait velocity, awareness of deficits) and falls as well as dual-task costs and dependent variable of falls.

Additionally, binomial and multinomial logistic regression were utilized to determine the most parsimonious model for predictors of falls in cognitively impaired older adults. Although the dependent variable (falls) was collected on a continuous level, it was not normally distributed. As mentioned earlier, falls data were dichotomized into fallers (falls of 2 or more) and non-fallers (zero or 1 falls) as well as trichotomized into non-fallers, single fallers, and recurrent fallers. Therefore, it was most appropriate to use logistic regression in this case. The each regression model included all 6 cognitive variables (single and dual-task conditions of working memory, verbal fluency, and visual attention) to identify significance. Statistical significance was set at 0.05 and analyses were conducted using SPSS 18.0 software.

Summary of Performance on Measures

Working Memory

In the single task condition of serial-3 retro calculation, participants completed a range of 0-28 correct responses per minute with an average of 5.12 (*SD* 6.12) correct responses per minute. No normative data was available for this measure. Under dual-task conditions, the range of performance was 0-34.09 correct responses per minute with the average being 5.37 (*SD* 6.87) correct responses per minute.

Verbal Fluency

Performance on the categorical naming task under the single task condition ranged from 4-24 correct responses per minute with a mean score of 13.02 (*SD* 4.68) correct responses per minute. Normative data for older adults age 80-89 is completion of 14.3 (*SD* 3.9) words per minute (Tombaugh, Kozak & Rees, 1999), indicating that in the single task condition the sample in the current study performed within one standard deviation of norms for older adults 80-89 years of age. Under the dual-task condition, performance ranged from 2.71-35.03 correct responses per minute with mean performance being 15.55 (*SD* 7.52) correct responses per minute.

Visual Attention

During the single task condition, performance on the counting dots task ranged from 0-16 correct responses per minute with a mean of 8.24 (*SD* 4.27) correct responses per minute; while performance under the dual-task condition ranged from 0-16.58 correct responses per minute with an average of 9.10 (*SD* 4.13) correct responses per minute. No normative data was available for this measure.

Gait Velocity

Gait velocity, measured under the single task condition, measured to be .56 (*SD* .17) meters per second. Normative data for older adults ages 80-89 indicates gait velocity of .82 meters per second as the overall mean for comfortable walking speed (Lusardi, Pellechia & Schulman, 2003). Normative data for frail older adults is .36 meters per second for men and .42 meters per second for women (Bohannon, 1997), indicating that the current sample was much slower than average older adults but faster than older adults labeled as frail. Under the dual-task conditions of working memory, verbal fluency,

visual attention, gait velocity reduced to .36 (*SD* .17), .34 (*SD* .14), .36 (*SD* .14) meters per seconds, respectively.

Awareness of Deficits

Form A of the Modified AQ-D was completed by the participant with a range of scores from .61 to 35 out of a maximal score of 78 and a mean score of 13.72 (*SD* 7.71), indicating that they almost never had problems or deficits in the listed activities. The caregiver of the participant completed Form B with a range of 0 to 45.23 out of a maximal score of 78 and a mean of 17.06 (*SD* 9.09), indicating that in their view, the participant did have some problems with most but not all of the listed activities. Overall, the caregiver reports indicate a slightly higher level of problems than did the participants themselves, therefore this sample does exhibit some lack of insight into deficits. The range of final scores (Form A – Form B) was -44.56 to 24 with a mean of -3.34 (*SD* 12.19).

Fear of Falling

Scores on the Short FES-I ranged from 7 to 28 out of a maximum of 28 with a mean score of 13.22 (SD 5.62) indicating participants in this sample were "somewhat concerned about falling".

Falls

Sixty-five percent (N=35) of the participants fell within the 12-months prior to participation in the current study including 49% (N=27) being recurrent fallers. On average, participants fell an average of 2.05 (SD 2.8) times in the 12-month period prior to participation in the current study.

Table II.

Ranges, Means, and Standards Deviations For Performance on All Measures.

Measure	Single Task Condition			Dual-task Condition		
	Range	Mean	*SD*	Range	Mean	*SD*
Serial-3 retro calculation (correct responses/minute)	0-28	5.12	6.12	0-34.09	5.37	6.87
Categorical naming (correct responses/minute)	4-24	13.02	4.68	2.71-35.03	15.55	7.52
Counting dots (correct responses/minute)	0-16	8.24	4.27	0-16.58	9.10	4.13
Gait velocity (meters/second)				.09-.76	.36[a]	0.17
	.15-1.06	.56	.17	.07-.69	.34[b]	0.14
				.11-.70	.36[c]	0.14

	Range	Mean	*SD*
Modified AQ-D (participant)	.61-35	13.72	7.71
Modified AQ-D (CG)	0-45.23	17.06	9.09
Awareness of Deficits score (CR-CG score)[d]	-44.56-24	-3.34	12.19
Short FES-I	7-28	13.22	5.62
Falls	0-16	2.09	2.81

	No Falls	Single Fall	Recurrent Falls
Falls	32.7%	16.4%	49.1%

Note. [a]Gait velocity with serial-3 retro calculation; [b]Gait velocity with categorical naming; [c]Gait velocity with counting dots. [d]Negative scores indicate that the caregiver scored the participant as more impaired than the participant's self-evaluation suggesting a lack of insight into deficits.

Results for Hypothesis #1

A negative correlation was hypothesized between falls as the outcome variable and several independent variables; therefore, bivariate correlations were used to test Hypothesis #1. No significant correlations were found between any of the independent variables: gait velocity, working memory, visual attention, verbal fluency, awareness of deficits; and falls when categorized as a dichotomized variable or trichotomized variable in this. See Table III for correlation coefficients.

These results indicated that the dependent variable of falls, either dichotomized or trichotomized, was not related to any of the cognitive measures under the single task condition, gait velocity as measured by the 10-meter walk test, or awareness of deficits as measured by the Modified AQ-D in this sample.

Table III.

Bivariate Correlations for Independent Variables and Falls.

	Falls - trichotomized	Falls - dichotomized
Gait Velocity	-.04	-.13
Working Memory	-.12	-.15
Verbal Fluency	-.02	-.07
Visual Attention	-.10	-.21
Awareness of Deficits	-.13	-.09

Summary of Performance Regarding Dual-Task Cost

Dual-task cost (DTC) is measured by the difference in performance from single

task condition and dual-task condition in both gait velocity and each cognitive task. A

positive DTC indicates worse performance on dual-task; while a *negative* DTC indicates

better performance under the dual-task condition. A summary of DTC can be found in

Table IV.

Table IV.

T-test Comparisons between Single and Dual-Task Conditions in Gait Velocity and

Cognitive Tasks

Pair (single/dual)	Mean DTC	SE	t	df
Gait velocity (single/WM)	.20	.02	12.70**	53
Working memory (single/dual)	-.26	.79	-.33	53
Gait velocity (single/VF)	.23	.02	13.95**	51
Verbal fluency (single/dual)	-2.36	.85	-2.77*	51
Gait velocity (single/VA)	.20	.02	11.57**	44
Visual attention (single/dual)	-.97	.57	-1.71	44

Note. WM = working memory, VF = verbal fluency, VA = visual attention, DTC = dual task cost. Positive DTC indicates worse performance on task during dual-task condition while negative DTC indicates improved performance on task during dual-task condition.
* $p < .05$, ** $p < .001$

Gait velocity suffered in all dual-task conditions. Under the working memory

condition, gait velocity DTC ranged from -.02 to .54 meters per seconds with a mean

DTC of .20 (SD .12) meters per second. During the dual-task condition of verbal

fluency, gait velocity DTC was measured with range of .01 to .44 meters seconds with average DTC of .22 (SD .18) meters per seconds. Finally, during the dual-task condition of visual attention, gait velocity DTC ranged from -.02 to .46 meters per second with mean DTC of .20 (SD .18) meters per second. Using repeated measures t-tests, gait velocity measurements significantly decreased under all dual-task conditions in this sample (working memory: $t= 12.70$, $p<.001$; verbal fluency: $t= 13.95$, $p<.001$; visual attention: $t= 11.57$, $p<.001$).

DTC for performance on working memory ranged from -16.57 (indicating better performance than under single task condition) to 23.81 correct responses per minutes with mean DTC being -.26 (*SD* 5.82) correct responses per minutes. Verbal fluency DTC demonstrated range of -18.70 to 7.29 with mean DTC of -2.36 (*SD* 6.13) correct responses per minute. Finally, DTC for the visual attention task provided range of -8.35 to 14.00 correct responses per minutes with average of -.97 (*SD* 3.79) correct responses per minute. When comparing the single and dual-task cognitive tasks, only verbal fluency demonstrated significant difference from single to dual-task condition ($t=-2.77$, $p=.04$).

Results for Hypothesis #2

As stated earlier, dual-task decrement or dual-task cost (DTC) was measured by the difference in performance from single task condition and dual-task condition in both gait velocity and each cognitive task. A positive DTC indicates worse performance on dual-task; while a negative DTC indicates better performance under the dual-task condition. A significant DTC was identified by dependent *t*-test between the single and dual-task condition.

Poorer performance in dual-task conditions, or high DTC, in gait velocity, working memory, verbal fluency, and visual attention was hypothesized to correlate positively with falls in older adults with cognitive impairment; therefore, bivariate correlations were used as well to test Hypothesis #2. Although the DTC were found to be significant in all measures of gait velocity and verbal fluency, no significant correlation was found between DTC and falls in this sample of cognitively impaired older adults indicating that poorer performance in dual-task conditions was not associated with an increased incidence of falls. A summary of these correlations can be found in Table V.

Table V.

Bivariate Correlations between DTC and Falls.

	Falls - trichotomized	Falls - dichotomized
DTC Gait velocity (working memory condition)	-.05	-.03
DTC Working memory	-.04	-.13
DTC Gait velocity (verbal fluency condition)	-.02	-.05
DTC Verbal fluency	.07	.15
DTC Gait velocity (visual attention condition)	-.01	.00
DTC Visual attention	-.15	-.19

Results for Hypothesis #3

Binomial & multinomial logistic regression was hypothesized to identify the most parsimonious group of predictor variables in identifying cognitively impaired older adults at higher risk of falls. It was predicted that dual-task working memory and visual attention would emerge as unique and significant predictors of falls in the cognitively impaired older adult while anosognosia would add significance as an individual difference measure.

Binomial logistic regression

A binomial logistic regression analysis was performed on falls as a dichotomized outcome (non- or single faller vs. recurrent faller) and six predictor variables: working memory (single), verbal fluency (single), visual attention (single), working memory (dual), verbal fluency (dual), and visual attention (dual). After deletion of 11 cases with missing values, data from 44 participants were available: 20 non- or single fallers and 24 recurrent fallers.

There was a good model fit on the basis of the six predictor variables (χ^2(8, N=44)=9.07, p=.34).A test of the full model with all six predictors was not statistically significant (χ^2(6, N=44)=4.71, p=.58) indicating that the set of predictors did not reliably distinguish non- or single fallers from recurrent fallers.

Table VI shows the regression coefficients, Wald statistics, odds ratios, and 95% confidence intervals for odds ratios for each of the six predictors. According to the Wald criterion, none of the predictor variables predicted falls in this sample. The odds ratios of the predictor variables (range .89 to 1.13) also show little change in the likelihood of falling based on a one-unit change in any of the predictor variables.

Table VI.

Logistic Regression Analysis of Falls as a Function of Cognitive Assessment

Variables	B	S.E.	Wald Chi-Square	Sig.	Odds Ratio
Working Memory (single)	-.06	.09	.46	.50	.94
Verbal Fluency (single)	.09	.09	.94	.33	1.10
Visual Attention (single)	-.11	.11	1.05	.31	.89
Working Memory (dual)	.13	.09	1.98	.16	1.13
Verbal Fluency (dual)	-.09	.07	1.43	.23	.92
Visual Attention (dual)	.10	.10	.83	.36	1.10
Constant	.02	1.16	.00	.99	1.02

Multinomial logistic regression

A multinomial logistic regression was performed to assess prediction of falls as a trichotomized outcome (no falls vs. single fall vs. recurrent falls) and six predictor variables: working memory (single), verbal fluency (single), visual attention (single), working memory (dual), verbal fluency (dual), and visual attention (dual). The category of non-faller was used as the reference category in this analysis. After deletion of 11 cases due to missing values, 44 cases were available for analysis: 13 non-fallers, 7 single fallers, and 24 recurrent fallers.

Tables VII and VIII show the regression coefficients, Wald statistics, odds ratios, and 95% confidence intervals for odds ratios for each of the six predictors in the multinomial logistic regression with non-faller as the reference category. According to

the Wald criterion, none of the predictor variables significantly differentiated groups. The odds ratios of the predictor variables (range .71 to 1.47), however, shows that a single unit change in visual attention in the single condition (one more correct response per minute) increased the likelihood of being a single faller by almost one and a half times.

Table VII.

Logistic Regression Analysis of Falls as a Function of Cognitive Assessment: Non-Faller vs. Single Faller

Variable	B	Std. Error	Wald Chi-Square	Sig.	Odds Ratio	95% Confidence Interval for Odds Ratio	
						Lower Bound	Upper Bound
Intercept	-4.07	2.46	2.75	.10			
Working Memory (single)	.14	.13	1.27	.26	1.15	.90	1.47
Verbal Fluency (single)	-.24	.22	1.26	.26	.79	.52	1.20
Visual Attention (single)	.38	.26	2.30	.13	1.47	.89	2.43
Working Memory (dual)	-.35	.18	3.80	.05	.71	.50	1.00
Verbal Fluency (dual)	.13	.11	1.50	.22	1.14	.92	1.41
Visual Attention (dual)	.12	.24	.27	.60	1.13	.71	1.79

Overall, regression analysis did not support the hypothesis predicting that dual-task working memory and visual attention would emerge as unique and significant

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predictors of falls in the cognitively impaired older adult while anosognosia would add

significance as an individual difference measure.

Table VIII.

Logistic Regression Analysis of Falls as a Function of Cognitive Assessment: Non-Faller

vs. Recurrent Faller

Variable	B	Std. Error	Wald Chi-Square	Sig.	Odds Ratio	95% Confidence Interval for Odds Ratio	
						Lower Bound	Upper Bound
Intercept	-.21	1.26	.03	.87			
Working Memory (single)	-.01	.10	.02	.89	.99	.80	1.21
Verbal Fluency (single)	.03	.10	.10	.75	1.03	.85	1.26
Visual Attention (single)	-.02	.12	.02	.90	.98	.77	1.25
Working Memory (dual)	.02	.10	.04	.84	1.02	.84	1.24
Verbal Fluency (dual)	-.03	.08	.13	.72	.97	.82	1.14
Visual Attention (dual)	.11	.11	.95	.33	1.12	.90	1.39

Additional exploratory analyses

Although no bivariate correlation or regression coefficients explicitly identified

any cognitive construct or predictor variable as a significant predictor of falls in this

sample, a further search into the results of the multinomial regression analysis was

warranted. The odds ratio of 1.47 found in the multinomial logistic regression for visual

attention indicated that a single unit change in visual attention under the single condition increased the likelihood of being a single faller by almost one and a half times. The logistic regression performed in this analysis used non-faller as the reference category, which compared non-fallers to single fallers as well as non-fallers to recurrent fallers. This type of analysis does not allow for comparison between the three groups simultaneously.

Based on findings indicating single condition visual attention may provide some explanation in differences between being a non-faller and single faller, an additional exploratory analysis was conducted to determine the significance of this finding in direct comparison among the three groups of fallers using analysis of variance (ANOVA). A significant difference between groups was noted on visual attention measured in single condition ($F_{2,45}$=3.05, p=.06). Post-hoc comparisons using Tukey test completed to identify significant difference between single faller and recurrent faller in visual attention task (mean difference 4.32, SE 1.76, p=.05) indicating that performance on the counting dots task in the single condition, which measured visual attention, was significantly better in the single faller than in recurrent fallers.

CHAPTER IV

DISCUSSION

The current study examined falls as a direct outcome measure in a sample of cognitively impaired older adults in efforts to better identify risk factors, including different cognitive processes, awareness of deficits, and gait velocity that may be unique to this group of individuals. Although no direct correlations or associations were found between falls and the predictor variables, several findings from participant performance in this study should be highlighted.

The incidence rate of falls in the current study was 65% demonstrating a rate of falling among this group of cognitively impaired older adults that is consistent with the literature. One in three community-dwelling older adults fall annually (Rubenstein et al., 1994) while cognitively impaired older adults have been documented to carry twice the risk (Tinetti et al., 1988; Eriksson et al., 2007). Other normative data available suggested that this sample performed within normal limits on the categorical naming test for verbal fluency; however, performance on verbal fluency did not support previous work finding

an association between verbal fluency and falls as discussed previously in results for first hypothesis (Bootsma-van der Wiel et al., 2003; Holtzer et al., 2007). The average gait velocity in this sample fell below the average gait velocity for older adults 80-89 years of age (Lusardi, 2003) but above those categorized as frail (Bohannon, 1997). In general, these findings highlight that although the sample is older than much of the current literature on fall prediction, their performance on the assessments tools were in line with the available normative data. Also notable, much of the normative data utilizes healthy older adults while this sample of older adults exhibited mild to moderate cognitive impairment providing support to the utilization of standardized measures with samples of cognitively impaired older adults.

Additional information regarding this sample was gathered during execution of the dual-task activities. Under dual-task conditions, gait velocity significantly declined in all three cognitive tasks supporting previous literature including Montero-Odasso and colleagues (2009). Performance on cognitive tasks under dual-task conditions compared to the single task condition was quite variable in that the mean DTC was near zero with a great deal of variability across the sample. Beauchet and colleagues (2007) also found this variability in their sample of older adults on a working memory task but was able to identify that individuals performing better in the dual-task condition were at higher risk of falls. The current study was unable to support that finding in the current sample as discussed in results for the second hypothesis; however the previous study used a sample with a MMSE average of 25 indicating mild to no cognitive impairment which could explain the differences in findings.

Even though direct relationships were not found between falls and the cognitive constructs, visual attention emerged as a potential indicator of falls in older adults with cognitive impairment in the current sample. These findings support a growing body of literature (e.g., Nagamatsu, Liu-Ambrose, Carolana & Handy 2009; Owsley & McGwin, 2004) examining visual attention as a predictor of falls in older adults. Visual attention/processing was identified as a significant predictor of poorer scores on a performance mobility assessment (Owsley & McGwin, 2004). Individuals with deficits in the left visual field were identified as having a higher incidence of falls (Nagamatsu et al., 2009) leaving room for more research in this area.

Although projected hypotheses were not supported by findings, the current study adds a significant contribution to the literature. First, a sample of cognitively impaired older adults was used in the current study, making it the first study known to this author to measure cognitive processes in relationship to falls in a sample of all cognitively impaired older adults. Second, it demonstrates that cognitively impaired older adults are able to participate in a protocol involving a dual-task paradigm, although some older adults were not able to complete the visual attention task due to visual deficits which also could be true in a cognitively intact sample. Third, the current study demonstrates the possibility of multiple sources for the increased risk of falls in cognitively impaired older adults. Much of the current literature, including the work of Rubenstein and Tinetti mentioned earlier, identifies multiple factors leading to the increased risk of falls in older adults. It is possible that this is also true in samples of older adults with cognitive impairment; therefore, further research into possible interactions between diagnoses, cognitive and motor processes, awareness of deficits, and cognitive status is warranted.

For example, it may be plausible that awareness of deficits is only a significant predictor of falls in those older adults that have a higher gait velocity resulting in increased mobility. Increased incidence of falls was found in cognitively impaired older adults with greater mobility by Asada and colleagues (1996) but these authors did not examine awareness of deficits. Awareness of deficits was cited as a possible contributing factor in variations in gait velocity in persons with dementia in the study by van Iersel et al., (2006).

Finally, the current study identified visual attention as a promising cognitive process that deserves further analysis and research. Visual attention increased odds between non-fallers and single fallers in one analysis while differences between single and recurrent fallers were found in another. A deeper understanding of the link between visual attention and falls in the cognitive impaired older adult is necessary as this would be a simple assessment to add to any clinical evaluation. If visual attention can be solidified as a risk factor for falls in this population, many health care professionals can add this screening technique to flag individuals that may be at a higher risk for falls. This finding may lend explanation to why environmental hazards are the cited as the third largest cause of falls in nursing home residents (Rubenstein et al., 1994). Interventions targeting visual attention and environmental modifications to improve safety could be developed and evaluated to potentially modify this increased risk.

Limitations of the Current Study

There are several limitations that must be considered in the current study. First, the sample size in this study is relatively small and increasing the number of participants would boost the power for statistical analyses. Second, the sample utilized in this study

included individuals with mild to moderate cognitive impairments. It would be important to note that these findings may not generalize to individuals with different levels of cognitive ability. Third, participants were recruited from one area (i.e., Cleveland and Akron, Ohio regions), and included individuals with low levels of education, limiting the ability to generalize these findings to samples with different backgrounds and demographics. Also, the sample was recruited from skilled nursing and assisted living facilities, therefore, findings may vary in a community-dwelling population of older adults that are not under the care of medical professionals. The homogeneity of the sample also includes the level of cognitive impairment. With the narrow variability in the MMSE scores, one might conclude that there may have been limited ability to predict relationships as the sample could have performed at a higher range due to lower levels of cognitive impairment; thereby potentially demonstrating some ceiling effects on certain cognitive assessments. A larger, more diverse sample including more impaired individuals may have given way to better prediction. For example, individuals with more moderate cognitive impairment (MMSE=14-16) may have performed differently on cognitive tasks such as working memory or in the dual-task conditions than did those with mild cognitive impairment (MMSE=20-22) allowing for more potential interactions or linear relationships to emerge.

Finally, specific diagnosis or reason for cognitive impairment was not identified as most participants had a non-specific diagnosis of dementia or memory loss. Cognitive impairment was measured globally by the MMSE and CDT in this study. Individuals with different diagnoses resulting in cognitive impairment may present with different limitations and reasons for increased risk for falls. As discussed, cognitive impairment

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has been identified as a risk factor for falls but specific processes have not been identified. This study attempted to do so, however, it may be possible that specific diagnoses, such as Alzheimer's disease, vascular dementia, or frontotemporal lobar degeneration, may lead to differential increases and variability in these constructs as each of these types of dementia presents with varying decrements in cognitive processes. For example, individuals with Alzheimer's disease will have greatest deficits in memory and attention, whereas individuals with frontotemporal lobar degeneration will demonstrate greater loss of insight into deficits and executive function (Mendez & Cummings, 2003). Again, due to the small sample size in this study, these differences were unable to be identified possibly contributing to the non-significant relationships that were found.

Clinical Implications of the Current Study

The current study has a definite impact on the clinical practice of older adults with cognitive impairment. As stated earlier, the sample demonstrated that older adults with mild to moderate cognitive impairment are able to participate in standardized protocols and perform in line with normative data. They also were able to complete a dual-task paradigm including ambulation and cognitive tasks indicating that treatment option should not automatically be simplified due to a finding of cognitive impairment. It is important for health care professionals to understand that these older adults can be challenged and should be treated individually based on remaining strengths and capabilities found during assessment.

As mentioned earlier, different pathologies resulting in cognitive impairment may present with varying strengths and remaining abilities along with processes that demonstrate decrements requiring compensation. It is the responsibility of the clinician

to determine the individual's level of ability and focus on these remaining strengths to maximize success and optimize the individual's participation during treatment. A neuropsychologist or SLP may assist in determination of these remaining capabilities and processes requiring compensatory strategies through more in depth assessments if strengths and limitations are not evident upon initial screening.

Future Directions of Research

Extending the protocol to a larger and more diverse sample of cognitively impaired older adults would be ideal in efforts to increase statistical power as well as improve generalizability of any findings. With a large sample, researchers would be able to identify specific diagnoses and separate these groups to determine if different types of dementia and cognitive impairment result in different profiles. This also may help explain the high levels of variability in DTC found in this sample.

It may be beneficial to include a sample of demographically matched older adults without cognitive impairment. This addition would allow comparison of performance across various cognitive constructs as well as a comparison of variability on performance during dual-task activities. Having a sample of cognitively healthy older adults would allow researchers to determine with more certainty whether the findings were unique to the cognitively impaired participants or generalized across the entire sample of older adults.

As mentioned previously, the cognitive construct of visual attention showed potential relevance in predictions of falls in cognitively impaired older adults and would most certainly benefit from further investigation. Utilizing different techniques of

measuring visual attention along with a larger sample size would be indicated as a starting point for researchers.

Many authors also have investigated gait variability (e.g., stride length, base of support) in addition to gait velocity (Sheridan, Solomont, Kowall & Hausdorff, 2003; Springer, Gilaldi, Peretz, Yogev, Simon & Hausdorff, 2006; Toulotte, Thevenson, Watelain & Fabre, 2006) in health older adults. Measurements of gait variability should be an area of further research with cognitively impaired older adults as gait velocity may not be sensitive enough to identify variations in gait that may lead to higher risk of falls.

An additional measure of executive function, such as the Trail Making Test, may be beneficial in further investigations into the relationship between falls and cognitive processes in this sample of older adults. Finally, further analyses examining interactions between variables such as awareness of deficits or fear of falling with cognitive measures are warranted due to high levels of variability in dual-task performance. These possible interactions, as discussed above, may highlight reasons for this variability as well as identify processes that rely on each other to predict this higher risk of falls in older adults with cognitive impairment.

Finally, consideration regarding retrospective versus prospective measurement of falls should be closely considered. The rate of cognitive decline is certainly a concern over a 12-month period whether cognition is measured prior to collection of falls data or measured following occurrences of falls. One possible protection against this could be the collection of falls data prospectively, while also assessing cognition at multiple points throughout the 12-month period. This would allow researchers to determine whether the rate of change is significant in each participant and whether the rate of change is

predictive of falls in the sample. Continuing this line of inquiry is important to the field

of aging in order to aid in the development appropriate assessment tools and interventions

to reduce the risk of falls in older adults with cognitive impairment.

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APPENDICES

Appendix A.

Method for evaluating clock drawings described by Watson and colleagues (1993).

1. Divide the circle into 4 equal quadrants by drawing one line through the center of the circle and the number 12 (or a mark that best corresponds to the 12) and the second line perpendicular to and bisecting the first.
2. Count the number of digits in each quadrant in the clockwise direction, beginning with the digit corresponding to the number 12. Each digit is counted only once. If a digit falls on one of the reference lines, it is included in the quadrant that is clockwise to the line. A total of 3 digits in a quadrant is considered to be correct.
3. For any error in the number of digits in the first, second or third quadrants assign of score of 1. For any error in the number of digits in the fourth quadrant assign a score of 4.
4. Normal range of score is 0-3. Abnormal (demented) range of score is 4-7).
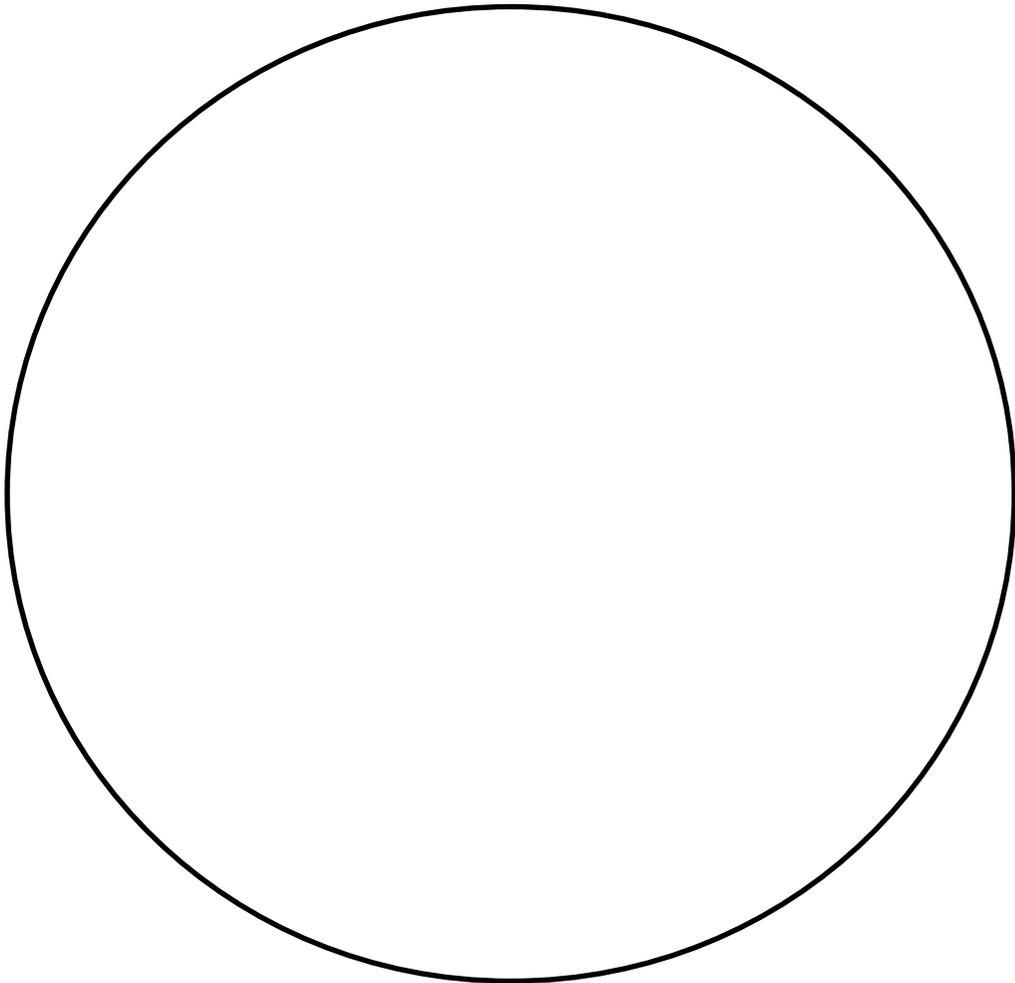
Appendix B.

Modified Anosognosia Questionnaire-Dementia (patient version): (Migliorelli et al., 1995)

Each question is rated by the participant on a scale from 0 (never) to 3 (always). A higher score indicates more impairment. In the original format, Form A is answered by the participant alone while Form B is answered by the caregiver separately from the participant and blind from the participant's answers. Final scoring in the original AQ-D is completed by subtracting scores of the caregiver from those of the participant. Negative scoring indicates the caregiver rated the participant as more impaired, while a positive score indicates the participant perceives more impairment than the caregiver.

A. Intellectual Functions
1. Do you have problems remembering the date?
     never   sometimes   often   always
2. Do you have problems orienting yourself in new places?
     never   sometimes   often   always
3. Do you have problems remembering telephone calls?
     never   sometimes   often   always
4. Do you have problems understanding conversations?
     never   sometimes   often   always
5. Do you have problems signing your signature?
     never   sometimes   often   always
6. Do you have problems understanding what you read in the newspaper?
     never   sometimes   often   always
7. Do you have problems keeping your personal belongings in order?
     never   sometimes   often   always
8. Do you have problems remembering where you leave things in your room?
     never   sometimes   often   always
9. Do you have problems writing notes or letters?
     never   sometimes   often   always
10. Do you have problems orienting yourself in the facility?
     never   sometimes   often   always
11. Do you have problems remembering appointments?
     never   sometimes   often   always
12. Do you have problems practicing your favorite hobbies?
     never   sometimes   often   always
13. Do you have problems communicating with people?
     never   sometimes   often   always
14. Do you have problems doing mental calculations?
     never   sometimes   often   always
15. Do you have problems controlling your sphincters?
     never   sometimes   often   always
16. Do you have problems understanding the plot of a movie?
     never   sometimes   often   always

17. Do you have problems doing daily activities (getting dressed)?
    never   sometimes   often   always
18. Do you have problems feeding yourself?
    never   sometimes   often   always

B. Behavior
19. Are you more rigid in your decisions, with less capacity to adapt to new situations?
    never   sometimes   often   always
20. Are you more egotistic, paying less attention to other people's needs?
    never   sometimes   often   always
21. Are you more irritated? Do you easily lose your temper?
    never   sometimes   often   always
22. Do you have crying episodes?
    never   sometimes   often   always
23. Do you laugh in inappropriate situations?
    never   sometimes   often   always
24. Are you more interested in sexual themes, talking or reading about sex?
    never   sometimes   often   always
25. Have you lost interest in hobbies or activities you used to like?
    never   sometimes   often   always
26. Do you feel more depressed?
    never   sometimes   often   always

Patient Score: _____

Caregiver Score: _____

Final Score: (participant) _____ - (caregiver) _____ = _____

Modified Anosognosia Questionnaire-Dementia (caregiver version): (Migliorelli et al., 1995)

You are being asked to answer questions about the abilities of either your loved one or one of the residents that you care for in the facility. This individual will be answering the same questions that you are. Following completion of both surveys, the answers will be compared to assist the research in better understanding the participant's ability to understand his/her limitations.

A. Intellectual Functions
1. Does the participant have problems remembering the date?
    never   sometimes   often   always
2. Does the participant have problems orienting in new places?
    never   sometimes   often   always
3. Does the participant have problems remembering telephone calls?

never   sometimes   often   always

4. Does the participant have problems understanding conversations?
never   sometimes   often   always

5. Does the participant problems signing his/her signature?
never   sometimes   often   always

6. Does the participant problems understanding what he/she read in the newspaper?
never   sometimes   often   always

7. Does the participant problems keeping personal belongings in order?
never   sometimes   often   always

8. Does the participant have problems remembering where he/she leaves things in his/her room?
never   sometimes   often   always

9. Does the participant have problems writing notes or letters?
never   sometimes   often   always

10. Does the participant have problems orienting in the facility?
never   sometimes   often   always

11. Does the participant have problems remembering appointments?
never   sometimes   often   always

12. Does the participant have problems practicing his/her favorite hobbies?
never   sometimes   often   always

13. Does the participant have problems communicating with people?
never   sometimes   often   always

14. Does the participant have problems doing mental calculations?
never   sometimes   often   always

15. Does the participant have problems controlling his/her sphincters?
never   sometimes   often   always

16. Does the participant have problems understanding the plot of a movie?
never   sometimes   often   always

17. Does the participant have problems doing daily activities (getting dressed)?
never   sometimes   often   always

18. Does the participant have problems feeding yourself?
never   sometimes   often   always

B. Behavior

19. Is the participant more rigid in your decisions, with less capacity to adapt to new situations?
never   sometimes   often   always

20. Is the participant more egotistic, paying less attention to other people's needs?
never   sometimes   often   always

21. Are you more irritated? Does he/she easily lose his/her temper?
never   sometimes   often   always

22. Does the participant have crying episodes?
never   sometimes   often   always

23. Does the participant laugh in inappropriate situations?
never   sometimes   often   always

24. Is the participant more interested in sexual themes, talking or reading about sex?

      never   sometimes   often   always

25. Has the participant lost interest in hobbies or activities you used to like?

      never   sometimes   often   always

26. Does the participant feel more depressed?

      never   sometimes   often   always

Caregiver Score: _____

Short Falls Efficacy Scale – International (Kempen et al., 2008)

Introduction:

Now we would like to ask some questions about how concerned you are about the possibility of falling. Please reply thinking about how you usually do the activity. If you currently do not do the activity, please answer to show whether you think you would be concerned about falling IF you did the activity. For each of the following activities, please tick the box which is closest to your own opinion to show how concerned you are that you might fall if you did this activity.

1. Getting dressed or undressed
2. Taking a bath or shower
3. Getting in or out of a chair
4. Going up or down stairs
5. Reaching for something above your head or on the ground
6. Walking up or down a slope
7. Going out to a social event (e.g. religious service, family gathering or club meeting)

Answer options:

1. Not at all concerned
2. Somewhat concerned
3. Fairly concerned
4. Very concerned

Handling Short FES-I sum scores:

To obtain a total score for the Short FES-I simply add the scores on all the items together, to give a total that will range from 7 (no concern about falling) to 28 (severe concern about falling).