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THE IMPACT OF STRESS ON
OLDER ADULT CAREGIVERS' EVERYDAY MEMORY

By

Jessica H. Anderson

Accepted in Partial Completion
Of the Requirements for the Degree
Master of Science

Moheb A. Ghali, Dean of the Graduate School

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MASTER'S THESIS

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Jessica H. Anderson

May 19th, 2010

THE IMPACT OF STRESS
ON OLDER ADULT CAREGIVERS' EVERYDAY MEMORY

A Thesis
Presented to
The Faculty of
Western Washington University

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Of the Requirements for the Degree
Master of Science

By

Jessica H. Anderson
May 2010

Abstract

The goal of the present study was to explore the relationship of stress with everyday memory and basic cognitive abilities in informal older adult caregivers. Caregivers completed a pseudo-medication regimen, measured using an electronic pill cap. The cap monitored the number of openings and the timing of the openings for 14 days. In addition, caregivers completed a daily stress assessment. Hierarchical linear models found no effect of stress, but speed of processing and working memory were related to the correct timing of openings. A cross-level interaction of speed of processing with stress on the timing of openings was found. Individuals with lower speed of processing scores improved their performance with stress. Overall, cognitive resources are predictive of everyday memory performance.

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Table of Content

Abstract.....	iv
List of Figures and Tables.....	vii
Introduction.....	1
Methodology.....	19
Results.....	28
Discussion.....	41
Conclusion.....	47
References.....	49

List of Figures and Tables

Descriptives of Participant Characteristics.....	29
Means and Standard Deviations for Activity.....	30
Means and Standard Deviations for Performance.....	30
Standard Errors for HLM Model One.....	33
Standard Errors for HLM Model Two.....	35
Main Effect of Speed of Processing.....	36
Main Effect of Working Memory.....	36
Interaction of Stress and Speed of Processing.....	37
Correlations of Cognitive Variables.....	39
Means and Standard Deviations for Cognitive Variables.....	40
Correlations of Stress Variables.....	40

The Impact of Stress on Older Adult Caregivers' Everyday Memory

The number of individuals diagnosed with the debilitating disease of Alzheimer's has dramatically increased in recent years. The Alzheimer's Association (2007) estimates that there are currently five million people in the United States alone with this form of dementia. The Center for Disease Control (CDC) reports that with the many different types of dementia, 8.5-9.8 family members are currently caring for a loved one. Researchers foresee an additional 454,500 new cases each year (Alzheimer's Association, 2009). Each of these diagnoses place a seemingly insurmountable burden on family members as the need to provide care can become the center of their daily life. This can have serious ramifications for those who care for a loved one as Alzheimer's disease is a long lasting and pervasive illness. Research is needed to understand how the stress of caregiving impacts caregivers' everyday life.

Older Adult Informal Caregivers

Caring for an individual with Alzheimer's disease brings unique challenges that caregivers for individuals with other disorders may not face. The National Institute of Health (NIH, 2009) argues that the loss of cognitive abilities and personality changes that characterize dementia may increase the level of burden experienced by informal caregivers. The daily tasks of caregiving such as feeding, clothing, bathing, and toileting can be especially challenging as they are compounded by the pressures of managing the effects of their care-recipients' cognitive deterioration. In addition to the tasks of personal care, caring for a loved one with dementia also involves managing finances, medications,

providing supervision to prevent wandering, preparing meals, and responding to the behavioral symptoms of dementia. Despite all of these demands, 47% of all caregivers report that they receive no paid outside assistance (NIH, 2009). Thus, many caregivers are facing the brunt of the physically and emotionally challenging tasks alone. According to the National Alliance for Caregiving (2008), those 65 and older are more likely to have been caregivers for a great number of years and to spend more hours per week caregiving than younger adult caregivers. Due to the challenges associated with one's own aging, the duties of being an informal primary care provider may be even more arduous for older adults than younger adults. For many older adults, these duties are fulfilled in addition to managing their own medications and illnesses (Vitaliano, Katon, & Unutzer, 2005). Therefore, informal older adult caregivers are not only caring for a loved one, but are also in a stage of life associated with their own normative declines in physical and cognitive functioning. Because of the changes associated with aging and the challenges of providing care, older adult informal caregivers are a unique population. These older adults are under a great deal of pressure while they are also experiencing their own normative age-related cognitive declines. Researchers have found that stress impacts performance on cognitive tasks (e.g., Stawski, Sliwinski, and Smyth, 2006). Importantly, the areas of cognitive functioning that are most impacted by stress are also the same cognitive abilities that show decrements with age. Few studies have specifically explored how caregiving is related to the cognitive functioning of the caregiver (Vitaliano et al. 2006). Furthermore, no researchers have explored how this chronic stress might interfere with the daily functioning of the caregiver. Before the relationship with stress and older

adults cognitive abilities can be determined, it is necessary to consider what age related declines are normal in older adults who are not experiencing chronic stress.

Normative Aging and Cognition

It is possible that normative changes might impact everyday functioning – especially when an individual, due to health or circumstances, is already at risk for cognitive failures and/or problems. Indeed, there is much evidence to suggest that some cognitive declines are associated with aging (e.g. Salthouse, 1990, Salthouse, 2004, Dixon and de Fraix, 2004, Henry, 2000). Longitudinal studies have delineated the normative changes that older adults, like caregivers, experience regardless of other life circumstances. These declines have been detected through standardized laboratory assessments. One advantage to this methodological design is that it allows individual differences to be measured over an extended period of time. Two prominent studies, the Seattle Longitudinal study (Hertzog & Schaie, 1983) and the Victoria Longitudinal Study (Hultsch, Hertzog, Small, McDonald-Miszczak, & Dixon, 1992; MacDonald, Dixon, Cohen, & Hazlitt, 2004) found that most adults transition to a period of decline sometime during the mid-50s to early 70s on at least one rudimentary ability, such as working memory (Schaie and Hertzog, 1983). Even without chronic stress, some degree of cognitive decline is likely during the elder years.

Salthouse and Babcock (1991) found that when exploring age differences in working memory, older adults demonstrated marked performance declines relative to a younger comparison group. Working memory is a broad cognitive function that is necessary for more complex higher ordered processes. This cognitive resources allows

for the active storage and manipulation of information in memory (Baddeley, 1986). Salthouse and Babcock (1991) describe working memory as being comprised of three distinct mechanisms that are necessary for optimum performance. These are processing efficiency, storage capacity, and coordination effectiveness. Processing efficiency is how well operations are able to be completed whereas storage capacity is related how much information is able to be maintained. The final component, coordination effectiveness, is responsible for the management of effective processing and information storage in working memory. Salthouse and Babcock (1991) argue that many of the decrements in performance that older adults exemplify on cognitive tasks (e.g., episodic memory) may be due to a reduction in working memory capacity. Fewer working memory resources make it more difficult to carry out complicated, time-sensitive memory operations. For example, listening to and understanding medication instructions while in a doctor's office may become more challenging as we age because there are fewer cognitive resources to attend to and encode the information.

Working memory is not the only area that appears to decline. Cognitive abilities are interconnected and declines in one area can often be found in another. Salthouse (1996) also found that, relative to a younger aged comparison group, older adults' demonstrated slower speed of processing on the Digit Symbol Substitution task. Slower speed of processing has important implications for optimal functioning in everyday life. As mentioned previously, older adults may have more difficulty with medication adherence instructions due to declines in working memory. Declines in speed of processing can also make this task more difficult. If a doctor speaks quickly when

providing treatment information, an older adult will experience more difficulty remembering the instructions than a younger adult because it takes longer to process the incoming information. Speed of processing declines beginning early in adulthood, mean-level changes can be detected as early as the mid-20s. These declines appear to be confined to speed of processing and are negligible in terms of performance, but demonstrate the early beginnings of normative cognitive decline (Salthouse, 2004).

In addition to declines in processing speed, working memory is also impacted by reduced attentional resources. McDowd and Craik (1988) demonstrated that fewer attentional resources become more evident as tasks become more challenging. Compared to younger adults, older adults had more difficulty performing dual-load tasks (tasks that require attending to multiple stimuli at the same time). Increased difficulty with complex tasks has pertinent implications for cognitive performance in real life situations.

Caregivers may often be placed in a situation that requires them to attend to multiple tasks at the same time. Furthermore, McDowd and Shaw (2000) found that older adults demonstrated more difficulty than younger adults in performance on a variety of selective attention tasks and that these declines increased over time. These challenges could be due in part, to the reduction in working memory ability, which limits the amount of information that an individual can attend to at one time (Park, Morrell, Hertzog, Kidder, & Mayhorn, 1997; Salthouse, 2004).

Although there is substantial support that some decline occurs in basic cognitive abilities, the research summarized above is limited. How other contextual factors such as stress affect older adult's cognitive performance in the real world still need to be

addressed. Declines in rudimentary cognitive abilities do not directly imply that older adults are incapable of maintaining high levels of functioning in their daily lives.

Salthouse (1990) argues that there is a discrepancy seen between older adults' abilities measured through laboratory measures and how well they are able to perform life relevant tasks. Therefore, although older adult caregivers may demonstrate typical age related cognitive declines, these declines may not necessarily translate into performance decrements in daily tasks.

Everyday Memory

Researchers have suggested that highly developed domain-specific knowledge may enable older adults to perform life-relevant tasks well (i.e., managing finances and taking medications) despite some decrements in basic cognitive abilities (e.g., Salthouse, 1984; Lindeberger, Kliegl, & Baltes, 1992). Expertise in everyday tasks may serve as a buffer to prevent normative cognitive declines from impacting daily life. For example, when studying typists, older adults were able to maintain proficiency in their typing speed even though they also demonstrated age related differences in speed of processing. The typical age related declines in speed of processing did not translate into declines on the typing task because these older adults had high levels of expertise in this skill (Salthouse, 1984). In other studies, Lindeberger, Kliegl, and Baltes (1992) found that older adults performed significantly better than inexperienced younger adults on a task with which they had previous experience and the younger adults had none. Therefore, cognitive declines alone do not necessarily imply an inability to perform everyday tasks well (Weatherbee & Allaire, 2008).

There is a relationship between performance on measures that are designed to mimic everyday tasks and basic cognitive ability (Willis and Marsiske, 1993). A decrease in overall cognitive resources may cause an individual to have more difficulty successfully completing instrumental activities for daily living (IADL), despite some domain specific knowledge. These are tasks such as managing finances, taking medications, and housework (Odheimer & Minaker, 1994). For example, Burton, Strauss, Hultsch, and Hunter (2006) found that problem solving scores for decisions based on daily tasks such as financial and meal planning were directly correlated with cognitive scores. Overall, 49 percent of the variance in performance on the everyday problem solving measure was explained by the cognitive measures and basic demographics such as education. Willis, Jay, Diehl, and Marsiske (1992) obtained similar findings when monitoring performance on standardized measures of everyday memory over a 7 year period. During this time, participants transitioned from the young-old to old-old years, which are typically associated with accelerated cognitive decline (Salthouse, 1992). However, the majority of older adults did not demonstrate performance declines on the everyday memory measure. When decline occurred, it was predicted by the specific cognitive measures of verbal knowledge, declarative memory, and inductive reasoning. Therefore, domain-specific knowledge and basic cognitive resources are related to everyday memory and are vital in understanding how older adults' memories work on life-relevant tasks (Allaire & Marsiske, 1999).

When determining what rudimentary abilities are necessary for everyday tasks, the skills associated with that specific task need to be considered. Various daily tasks, like

medication adherence, can rely on different cognitive abilities (Willis, Jay, Diehl, & Marsiske, 1992). It is important to consider the type of everyday memory measure that is used. Different forms of everyday memory measurement may not necessarily reflect the same constructs. Marsiske and Willis (1995) argue for multidimensional approach that considers the wide span of abilities that are related to the task. Allaire and Marsiske (2002) explored two different measures of everyday cognition. They categorize these measures as using either a well- or ill-defined approach. A well-defined approach incorporates traditional cognitive assessments and is generally answered by a single solution. Ill-defined problems, which typify the type often encountered in everyday life, have many possible solutions. In this study, they compared measures that used a well-defined approach to ill-defined measures of everyday cognition. It was found that the cognitive measures had more predictive validity for well-defined measures than for ill-defined measures, but performance on both measurement techniques were related to each other. Allaire and Marsiske suggest that this further demonstrates the need to explore every day cognitive performance within the specific context of interest. Traditional assessments of cognition can limit older adults' ability to reach a solution. Therefore, findings utilizing this methodology may imply that older adults are "worse off" cognitively than they truly are.

The everyday cognition literature provides unique insight regarding how older adults are able to remain highly functional, despite some declines in cognitive recourses. However, many of these studies are still conducted in a laboratory setting using standardized assessments. Many questions regarding how functioning occurs outside on a

daily basis still remain unanswered. Also lacking is any attention to how stress may impede performance of an ongoing everyday memory task. Stress has an impact on basic cognitive resources (e.g., Klien and Boals), however it is unknown if this in turn affects everyday memory. Specifically, the chronic stress of caregiving could impact the availability of cognitive resources and make everyday memory tasks more challenging for caregivers. The ability to effectively carry out everyday tasks, like medication adherence, is important for the caregiver's and care-recipient's health.

Medication Adherence: An Important Everyday Memory Task for Older Adults

One task that is highly relevant to maintaining optimal health is medication adherence. Successful medication adherence is often an underappreciated cognitive task that extends beyond taking a pill at a certain time (Insel, Morrow, Brewer, & Figueredo, 2006). A complex array of underlying cognitive processes are necessary to ensure that the correct amount is taken, at the correct time, while also adhering to medication specific instructions (e.g., take with food). This process can become increasingly challenging when an individual must adhere to multiple medications, each with their own specific instructions (Morrell, Park, Kidder, & Martin, 1997; Park & Kidder, 1996). Park (1994) suggests that the cognitive component may be more relevant for older adults as success in the task relies on comprehension, working memory, prospective memory, and reasoning. All of which are areas that have shown evidence of normative age-related declines.

Researchers suggest that executive functioning (responsible for planning and monitoring) plays a vital role in prospective memory performance and medication

adherence (d'Ydewalle, Bouckaert, & Braunfaut, 2001). Age associated neurological decay has been found in the frontal areas of the brain where executive functioning is centered (e.g., Shallice & Burgess, 1991; Glisky, 1996). Fewer executive resources can lead to difficulties in tasks like medication adherence. Insel et al. (2006) followed individuals' medication adherence using an electronic cap that monitored each time the bottle was opened over an eight week period. Adherence to their actual medication was predicted by assessments of cognitive functioning. Executive functioning was measured using the Wisconsin Card Sorting Task, an organization task that requires participants to sort cards on the basis of matching to certain principles. Older adults who had a higher number of preservative errors (errors that indicated they did not apply new information in order to prevent future errors) had more difficulty with adherence to their medications. The monitoring capabilities of the executive system may be necessary to successfully complete everyday memory tasks. However, successful adherence also requires other cognitive resources.

Prospective memory is thought to be the memory mechanism through which medication adherence is performed (Einstein & McDonald, 1999). Prospective memory tasks are defined as being either event-based (i.e., remember to do something at the sound of an alarm) or time-based (i.e., remembering to perform a task after a certain amount of time has passed). D'Ydewalle, Bouckaert, and Braunfaut (2001) argue that time-based prospective memory task, due to the self-initiative requirements, may suffer more as a result of declines in executive functioning. Time-based tasks in particular may place a greater strain on the executive system because it is an on-going process. If individuals are

having more difficulty monitoring their behavior, performance on self-initiated tasks, like time-based prospective memory, decreases. Because event-based tasks are dependent upon fewer resources, it is less susceptible to declines in executive functioning.

How age affects prospective memory performance was explored by Rendell and Thomson (1994) who used a simulated medication regimen prescribed to five different ages. Rather than using a placebo, participants were instructed to press a button on an electronic box that monitored their adherence to the pseudo-medication regimen. Over a two week period, the regimen varied, getting more complex over time. Rendell and Thomson found that task complexity (once a day versus four times a day) did not impact older adults' performance on the task. Furthermore, the researchers found that the older adult's adherence to the simulated medication regimen exceeded that of the younger adults. They suggested older adults performed better than younger adults because of the differences in the complexity of their schedules. Older adults may have fewer demands on their time which allows them to devote more time to the task.

It is also possible that older adults perform better on the task because they utilize strategies that may help them compensate for cognitive declines. Tasks performed in real world settings are unique as older adults may also use external strategies to maintain adherence (Dixon, deFrias, and Backman, 2001). Older adults have reported utilizing more external memory strategies in studies of prospective memory. Dobbs and Rule (1987) reported that older adults were able to perform well on prospective memory tasks due to the use of external memory aids to compensate for a potential cognitive disadvantage. Fewer younger adults reported using any strategies to their advantage.

Dobbs and Rule postulated that older adults' beliefs about their memory, such that it is declining, might lead them to use more strategies that enable them to complete the task successfully.

In a meta-analytic review, Henry, MacLeod, Phillips, and Crawford (2004) consolidated multiple studies on prospective memory and age differences to explore effect sizes. Their analysis indicated that there was a discrepancy in older adults' performance based on the form of assessment used. Laboratory measures were associated with greater age-related deficits. These studies demonstrated some advantages to younger adults; however older adults outperformed the younger adults in naturalistic settings. Henry and colleagues concluded that the declines typically seen in laboratory measures do not translate into deficits in everyday life. One reason for this could also be that older adults are more motivated to succeed in the task. Therefore, in order to understand how chronic stress impacts an individual's ability to perform an everyday task, it is important to not only measure the degree of stress that characterizes one's life, but to have some assessment of his or her desire to perform the task well.

Effects of Stress & Older Adults' Cognition

The attention-depletion hypothesis is one explanation for how stress impacts cognitive resources (Klein & Boals, 2001). Thoughts associated with the stressor increase an individual's cognitive load. When stress increases, the demand becomes greater and begins to deplete resources that would otherwise be available for cognitive function. For example, if an older adult is experiencing high levels of stress he or she may divert most of their attentional resources to thinking about his or her problem. Thoughts consumed

with the stressor use resources that could otherwise be used to focus on tasks, like medication adherence. Sliwinski, Smyth, Hofer, and Stawski, (2006) found that the attention-depletion hypothesis explained cognitive performance in both younger and older adults task performance. However, they argued that stress could be more detrimental to older adults' task performance because they already have few cognitive resources available. Indeed, older adults who reported higher levels of distress and intrusive thoughts did not perform as well on episodic and working memory tasks as older adults with lower stress levels. In comparison of young, middle-aged and old adults, Vondras, Powless, Olson, Wheeler, & Snudden (2005) found that when stressed, older adults demonstrated more pronounced declines on cognitive tasks that required high attentional resources (i.e., the digit symbol substitution, verbal paired associates, incidental learning, and logical memory tasks in addition to measures of episodic memory), providing support for the idea that stress may be more detrimental for older adults. Researchers have also considered how these stressors vary on a day to day basis. Utilizing the Daily Inventory of Stressful Events (DISE) to monitor daily stressors Almedia, Wethington, & Kessler (2002) found a relationship with cognitive performance. Younger and older adults both demonstrated a decrease in cognitive performance on days when they experienced high levels of stress. Cognitive resources needed to perform well on highly demanding tasks could fluctuate with daily stress levels, which is not only consistent with the attention-depletion hypothesis (Klein & Boals, 2001), but suggests that stress and memory should be studied across time.

Researchers have also emphasized the importance of exploring specific types of stressors on memory performance (Rosnick, Small, McEvoy, Borenstein, & Mortimer, 2007). Rosnick et al. found differential cognitive performance among older adults that varied with the type of negative life event. Importantly, the mere presence of a stressor did not predict a decrement in cognitive performance. Some stressors were even associated with superior performance on a memory task, while others were linked to declines. They suggest that studies investigating older adults' reaction to stressful events and the impact that events have on cognitive functioning should focus on particular stressors in order to understand the specific impact of stress. Some types of stressors seem to be beneficial to cognitive performance. There is also evidence that reactions to stress may change with age. Neupert, Almedia, and Charles (2007) found that older adults reported less emotional reactivity in response to daily stressors than younger counterparts. This could be indicative of a general stress resilience that develops with age, which has been suggested by other researchers as well (e.g., Carstensen, Isaacowitz, & Charles, 1999).

Stress alone does not predict cognitive performance. Rosnick and colleagues (2007) argued that the impact of stress needs to be evaluated in a situational specific manner, as not all stressors elicit the same response. In understanding how the chronic stress of caregiving impacts everyday memory, both the types of stressor and the specific cognitive abilities related to an everyday memory task need to be carefully considered. As noted by Stawski, Sliwinski, & Smyth (2006), stress may be more detrimental for older adult caregivers' cognitive performance as they are already at a period of life

associated with normative declines. However, none of these studies exploring the impact of stress on cognitive performance have explored one specific stressor (like caregiving) on a daily memory task.

Older Adult Caregivers and Cognition: Everyday Stress and Memory

How the facets of cognition described above operate within a taxing (e.g., stressful) environment, like that of caregiving is relatively unknown. Spousal caregivers of individuals with Alzheimer's have demonstrated declines in basic cognitive abilities. In comparison with non-caregivers of the same age, Caswell, Vitaliano, Croyle, Scanlan, Zhang, and Daruwala (2003) found that caregivers demonstrated lower psychomotor speed measured by the digit symbol substitution task. These findings were still significant after the researchers controlled for depression, indicating that negative affect alone cannot account for the decline. Declines in speed of processing are pertinent as cognitive theories tout it as being the basis for higher ordered functioning (Baddeley, 1986; Salthouse, 1992).

Studies using more extensive methodology and measures also provide evidence that cognitive declines may be influenced by stress. This was the primary focus of Vitaliano and colleagues (2006) as they investigated how the prolonged stress of caregiving may affect other aspects of cognitive functioning (as measured using laboratory assessments). Older adult caregivers' physical health and cognitive functioning were followed longitudinally across a two-year period. Measures of abstract and verbal reasoning from the Shipley Institute of Living Scale were used in conjunction with physiological

measures of health to monitor changes over time. At time one of the study, there were no significant differences between caregivers and non-caregivers on either cognitive measure. Both groups demonstrated declines on the abstract reason measure that was not atypical for age related cognitive declines. However, caregivers' scores on the verbal reasoning measure decreased by an average of one point that was greater than normative age related declines. In accordance with these findings, caregivers also demonstrated physiological markers of stress such as elevated risk for metabolic disorders, such as diabetes. Older adult caregivers may experience an accelerated deterioration of cognitive resources due to the chronic stress they experience. Although the Vitaliano et al (2006) study has vital implications for understanding caregiver well-being and health, this study does not address what the implications are for everyday memory functioning.

Present Study

The primary goal of the present study is to expand upon the research summarized above by exploring how stress impacts memory on a daily basis for older adult caregivers. Focusing on caregivers is important for two reasons. Most importantly, these are individuals that may be experience tremendous burden. If this stress is impacting their everyday memory, it could have an impact on their ability to provide proper care. Second, not all stressors are associated with cognitive decline. Therefore, it is important to focus on a specific stressor, like caregiving, as different stressors can influence cognitive resources in different ways (Rosnick et al., 2007). The Vitaliano et al. (2006) study was the first to explore how the stress of caregiving may contribute to age related cognitive declines in the elderly. Although important, the findings do not provide any

insight into how these cognitive changes are related to everyday memory function. A task that older adult caregivers complete on a daily basis is needed to determine if the chronic stress of caregiving impacts everyday memory performance. Therefore, this study will use a pseudo-medication regimen that informal older adult caregivers will complete daily. Allaire & Marsiske (2007) noted that not all everyday memory tasks rely on the same underlying cognitive resources. In order to properly understand how caregivers perform on a pseudo-medication task, it is necessary to use measures of cognitive skills that are specific to that task.

Second, this investigation will explore the cognitive relationships between the everyday memory task and standardized assessments of rudimentary abilities. The methodology proposed will focus on how speed of processing, working memory, and executive functioning are associated with performance on the pseudo-medication regimen. These variables have all demonstrated some relation with medication adherence (Park, 1994). Although a simulated medication regimen is not the same as taking an actual prescription medication (i.e., it is not actually a treatment for anything, a factor that can play into adherence), it should rely on the same cognitive skills. Caswell et al. (2003) found that caregivers demonstrated slower speed of processing than similar aged non-caregivers, which has implications for other domains of cognitive ability (Salthouse, 1992). The relationship between executive functioning and other cognitive processes is unexplored. Executive functioning may be crucial to complex cognitive tasks like medication adherence (Insel, Morrow, Brewer, & Figueredo, 2006).

Finally, this study will also add to the understanding how stress impacts older adult caregivers by using multi-level modeling. Researchers (Hultsch, Strauss, Hunter, & MacDonald, 2008; Stawski, Sliwinski, & Smyth, 2006) have argued that when exploring cognitive functioning with older adults, it is important to explore within-person variance, rather than between-person variance through multi-level modeling. Stawski, Sliwinski, and Smyth (2006) contend that this kind of analysis is more theoretically relevant because it provides insight into how the individual varies across time or occurrences rather than exploring mean group differences (i.e., how an individual's performance changes as a function of their own mean, rather than looking at between group differences (Brosboom, Mellenbergh, & van Heerden, 2003)). Monitoring each individual's performance across time provides specific information regarding how particular stressors and events can affect memory that may not be demonstrated on a single time measure. Measuring each individual's performance over a specific duration of time would allow changes in that person's performance to be followed in accordance to the number of stressors that he or she reports.

There are multiple ways in which an everyday memory task, like the pseudo-medication regimen can be remembered. Ill-defined tasks, like the pseudo-medication regimen can provide older adults with a greater opportunity to compensate for cognitive declines (Allaire & Marsiske, 2007). How stress is related to this form of everyday memory is relatively unexplored in the stress and memory literature. As Rosnick et al. (2007) found, different stressors may have unique effects on cognitive abilities. To address this, daily stress assessments will be used in order to capture the number of

stressful events as well as the subjective stress level that each of the participants experience over a two week period. The stress assessments in conjunction with the everyday memory task will allow the intra-individual differences in caregivers to be explored. In summary, it is hypothesized that on days when caregivers experience higher levels of stress, they have more difficulty with the everyday memory. This would be consistent with the attention-depletion hypothesis (Klein & Boals, 2001).

Method

Participants

Participants were recruited through Alzheimer caregiver support groups in Whatcom and Skagit counties, in mid-sized towns located in the Pacific Northwest. The participants were 16 women and 2 men who were currently living with and providing full-time care for individual who had been diagnosed with dementia. Caregivers were on average 71.44 ($SD = 7.89$) years old and reported 15.77 ($SD = 2.90$) years of education. Full-time informal caregivers were defined as individuals who lived with the care-recipient attested that they provided the majority of care. The materials are listed in the order that they appeared in the protocol.

Materials

Demographics Questionnaire. Basic participant information was obtained at the beginning of the initial testing session. Specifically, participants were asked to provide their (a) chronological age, (b) the number of years of education obtained, (c) self-reported health (1= very poor to 5 = excellent), (d) the number of current medical

conditions they had, (e) if they had received a diagnosis of dementia or memory impairment, (f) number of medications they took on a regular basis, and (g) the number of pills that they took each day.

Activity Level and Control. Because participants' schedules can influence their ability to carry-out a complex task like the everyday memory task I gave them questions were developed to assess (a) the level of activity in their life (1 = not busy, I am bored – I need a lot more to do, 5 = extremely busy), (b) their satisfaction with their level of activity (1 = extremely dissatisfied, 5 = extremely satisfied), (c) how organized they felt their life was (1 = I am never organized, 5 = I am always organized), (d) how much control they felt they had (1 = I feel I did not have control over day to day activities in my life, 3 = I feel I have a lot of control over day to day activities in my life) , and (e) their level of happiness (1 = extremely unhappy, 5 = extremely happy). A composite score based the participants overall satisfaction score will be used.

Caregiver Information. In order to understand each caregiving situation, we asked participants (a) how many months the they had been a caregiver, (b) their total hours a week spent caregiving, (c) if they were currently a member of a support group (0 = No, 1 = Yes), (d) if they received outside assistance on a weekly basis (0 = No, 1 = Yes), if yes, how many hours of assistance the received per week, and (e) what their relationship with the care-recipient was (1 = Spouse, 2 = Parent, 3 = Friend, 4 = other).

Strategy Use. A measure assessing the number of strategies the participant used in order to adhere to their own medication regimens was collected. Participants were asked

if they used any strategies (1 = Yes, 0 = No), then read a list of common strategies and asked if it was something that they use to assist them in remembering. These included using an alarm clock, asking other people to remind them, using a pill organizer, leaving reminder notes in prominent places, related their medication times to their daily routine, leaving their pill box in a prominent place, writing a note when they've taken their medications, if they kept a list of times and amounts they had taken their medication, and if they counted their medication to ensure that they've taken it. If they affirmed using any of the strategies, they were asked how frequently they used this strategy (2 = everyday, 1 = less often than daily). The participants were then given the opportunity to state any additional strategies that they may use that did not fit into the given list. Any additional strategies given at this time were scored to see if they fit into any of the categories described above. If the strategy was new, a category for it was created. The sum of all strategies was created and used in this study.

Speed of Processing. The Digit symbol substitution task (Wechsler, 1981), is a measure of psychomotor speed. Participants were given 90 seconds to complete a series of boxes with the appropriate symbol. Successful completion of the task requires deciphering the key of symbols correctly and placing that symbol in the appropriate box as quickly and as accurately as possible. The number of correctly completed digit/symbols was used as the measure of processing speed in this study.

Working Memory. The Listening Span (Salthouse & Babcock, 1990) is an assessment of working memory. For this task, participants were read a set of sentences

aloud. The number of sentences in each set depended upon the level that the participants reached. After listening to a particular sentence in a series, the participants selected a multiple choice answer to a question about the sentence to demonstrate their comprehension. Once they listened to all sentences in the set and had chosen an answer for each sentence, the experimenter then asked the participants to recall the last word of each sentence that was read aloud in the sentence set. For example, a participant read a set of three sentences, would have to correctly recall the last word from each sentence (3 words). In order to proceed to the next level of difficulty, the participant must have correctly recalled the last words from 2 out of the 3 recall tests within a particular level. The number of sentences increased for each level successfully completed (e.g., if they were able to recall the last word for 3 sentences, they would be read 4 sentences on the following trial). The task was scored as the highest level completed. The minimum score was a 1, indicating that the participant was able to recall the last word of one sentence. In order to reach the maximum score of 8, participants needed to correctly recall the last word of 8 sentences. Higher scores indicate greater working memory capacity.

Depression. Because negative affect can impair memory and caregivers commonly suffer from negative affect, the CES-D (Radloff, 1977) was used to assess levels of depression in the sample. This scale contains 20 multiple choice-items that assess general depressive affect on a 4-point scale over the past week (e.g., “I feel depressed” and “I am happy”). Higher scores indicated higher levels of depression, with a

minimum score of 0 to a maximum of 60. Clinical depression is a score of 16 or above.

This measure had acceptable reliability with a Cronbach's alpha of .77.

Executive Functioning. The Wisconsin Card Sorting Test (WCST) is a measure of strategic planning and executive function that assesses an individual's ability to change cognitive strategies when given feedback (Grant & Berg, 1948). Participants are given a deck of 64 cards and asked to match each one to one of four key cards based on the various characteristics of the card. The cards can be matched according to color, number, or the form of the objects on the card. The participants must successfully match the card in the deck to one of the characteristics 10 times before moving on to the next category. The participants are then scored on the number of categories successfully. The categories are repeated until the participant has placed all 64 cards, resulting in a maximum score of 8. In order to receive a perfect score of 8, a clear understanding of how the categories shift after 10 correct responses is necessary. This indicates that the participant was able to use the information learned from previous trials and anticipate the correct matching principle. Perseverative errors are also scored. These errors occur when the participant fails to recognize that the correct category (e.g., color, form, or number) has changed and continues to incorrectly place the cards despite feedback indicating that their placement is incorrect. A higher number of these errors indicate poorer executive functioning and less strategic flexibility.

Everyday Memory. To measure memory in a realistic manner, a standardized everyday memory task was used. The participants were asked to adhere to a pseudo-

medication regimen for a two week period. In order to monitor participants' adherence, MEMs 6 electronic medication caps were used. This is a computerized medication cap that fits over a traditional medication bottle filled with placebos. It records the exact time and number of openings for each participant. Participants were told that the bottle did not contain a real medication and that they did not have to ingest the placebo. They were asked to take out one placebo 4 times a day, spaced between 3-4 hours apart. They were instructed that if they forgot to take a "pill", to take it as soon as possible and begin the 3-4 hour intervals again. Thus, the memory variables were (a) the absolute difference score of the number of memory errors made each day and (b) the number of openings per day that occurred at the correct time intervals.

Predictions of Performance. To assess performance expectations and motivation for the memory task, participants completed 4 questions that assessed what they anticipated their performance on the everyday memory task would be. These questions determined how difficult they expected the task to be (1 = very easy, 5 = very difficult), their level of interest in the task (1 = not interested, 3 = very interested) their motivation to do well on the task (1 = not motivated, 3 = very motivated) and how well they thought they would perform over the next two weeks (1 = poor, 5 = excellent).

Everyday Memory Task Strategies. To measure strategic flexibility, a measure was created specifically for this study that asked participants to carefully consider the everyday task that they were being asked to complete over the next two-weeks. Specifically, they were asked to report any barriers that may affect their ability to

perform the task. For example, participants were provided with the example of how a vacation may disrupt their schedule and increase the likelihood that they would forget. After the participants relayed some potential barriers to their performance, they were asked to list some strategies that they might engage in to prevent the barriers from affecting their ability to adhere to pseudo-medication regimen. The total number of barriers and the total number of strategies reported were both scored.

Caregiver Burden. The Screen for Caregiver burden was developed by Vitaliano, Russo, Young, Becker, and Roland (1991). This measure contains 25 questions that assess the objective and subjective burdens placed on the caregiver. Objective measures included a quantitative account of the number of distressful occurrences that the caregivers have experienced. These questions refer to events that the caregiver regularly experiences such as, “My spouse throws fits and has been threatening me”. Subjective questions address caregiver’s emotional distress, such as “I feel so alone, as if I have the world on my shoulders”. The response scale ranges from 1 to 4 (1 = did not occur, occurred but caused no distress, 2 = mild distress, 3 = moderate distress, 4 = severe distress). The range of possible burden scores is 25 to 75. Higher scores on this measure indicated a higher level of burden. The Cronbach’s alpha in this sample was .89.

Daily Stress Assessment. Participants completed the daily inventory of stressful events (DISE) to complete each day for the two week period. The daily stress assessments, developed by Almedia, Wethington, and Kessler, (2002) asked participants 7 questions regarding the occurrence of stressful events throughout the previous 24 hours

using a series of structured questions. Both subjective severity and primary appraisal of the daily stressors were assessed. These events were not necessarily specific to caregiving. Participants were asked to consider if interpersonal, health, or financial events had occurred over the last 24 hours (1 = yes, 0 = no). The subjective severity measured how stressful the reported events were, (0 = not at all, 1 = somewhat, 2 = very), how much control they had over the situation (0 = none, 1 = a little, 2 = some, 3 = a lot), and if the issue was resolved (0 = no, 1 = yes). An additional question was added to the measure asking participants if they felt any additional stress due to the everyday memory task. Primary appraisal was measured by 7 questions. These questions determined the degree to which the stressful events impacted their daily routine, financial situation, opinions of self, opinions of others, physical safety, and future plans. These questions were scored on a 4 point scale (1 = not at all, 4 = a lot). Higher scores indicate a higher number of stressful events and distress on a daily basis. Scores range from 0 to 8 for events per day and 0 to 32 for distress.

Predictions of Performance. At the conclusion of the study, participants were given a second questionnaire that asked them to reflect on their performance of the everyday memory task over the past two weeks. These questions assessed how the participants found the task to be (1 = very easy, 5 = very difficult), how interesting they found the task to be (1 = not interesting, 3 = very interesting), how motivated they were (1 = not motivated to do well, 3 = very motivated to do well), and how well they thought they performed over the past week (1 = poor, 5 = excellent) on a Likert type scale. At this

time, participants were also asked to list any strategies that they used to help them remember to complete the task accurately. Of the strategies they reported, they listed what they felt were their most effective and ineffective strategies. Participants also stated any factors, positive or negative, that altered their performance. These reflections were placed in a separate envelope by the participant and sealed to in an effort to reduce any unease or social desirability.

Procedure

All participants met with an experimenter twice and participated for a two-week period. The initial session took approximately an hour. After demographic information was collected, participants were administered the protocol in the following order: the digit symbol substitution task, the CESD, WCST, and the Reading Span. Upon completion of the laboratory assessments, the standardized everyday memory task was introduced to the participants. They were given the placebo pill instructions as though the task were a pseudo-medication regimen. The participants were then introduced to the daily stress assessments. Once the participants felt comfortable with their daily tasks to complete over the next two weeks they were given the performance expectations questionnaire. To ensure that they felt that their responses would be confidential participants were given an envelope to place their completed questionnaires in. Questionnaires were not opened until after the completion of the study. The Caregiver Burden and Physician Satisfaction questionnaires were left with the participants to complete during the two-week period. At the completion of the two-week period, participants met with the experimenter for a final

time. The medication bottle, stress assessments and final questionnaires were retrieved. The participants completed the performance reflections questionnaire at this time.

Results

Means and standard deviations of the study variables are located in Table 1. Eighty-nine percent of participants rated their health as excellent or very good. On average, participants had been caregivers more than 5 years and spent an average of 81.35 (SD = 58.45) hours per week devoted to duties associated with caregiving. Only three participants were not members of a support group and most reported providing care without the use of any outside assistance. Seven participants received some assistance, with 5 reporting it as being less than 20 hours a week. Depression and caregiver burden scores were both low and below their respective criteria. This indicates that the caregivers in this sample were not experiencing high levels of distress. Because the impact of stress was the principle investigation, the findings of this study will be interpreted with this in mind.

Activity. The means and standard deviations for questions regarding the participants' satisfaction with daily activities are shown in Table 2. Participants reported that they felt they had some control over their lives, were organized, and relatively happy. Participants also reported that their schedules were busy, but that they were relatively satisfied with the level of activity. Overall, this indicates that this sample did not feel overwhelmed by their level of activity.

Performance. Participants reported high levels of interest in the task at the conclusion of the study. They also reported that they thought they performed the task relatively well and did not find it particularly challenging. Table 3 shows the means and standard deviations of these variables.

Medications. All participants were currently taking at least one prescription medication ($M = 5.39$, $SD = 3.09$) and reported using some strategies ($M = 2.67$, $SD = 1.14$) to help them remember to take their medications. This strategy information was useful as they could potentially use similar techniques for the everyday memory tasks.

Table 1

Descriptives of Participant Characteristics

Variable	M	SD
Age	71.44	7.89
Education	15.77	2.90
Depression	9.94	5.95
Burden	1.98	.52
Number of Years Caregiving	6.56	6.79
Interest in the Task	2.65	.61
Motivation	2.69	.60

Note. A clinical criterion for depression on the Center for Epidemiologic Studies Depression Scale (CESD) is a score of 16 or higher. Task interest and motivation were scored on a scale of 1 (not at all) to 4 (extremely).

Table 2.

Means and Standard Deviations for Weekly Activity

Variable	M	SD
Control	2.22	.43
Organization	3.94	.73
Happiness	3.88	.47
Activity	4.33	.49
Satisfaction	3.66	.76

Note. Control was scored on a 1 (no control) to 3 (very controlled) scale. Organization, happiness, activity, and satisfaction were scored on a 1(none) to 5 (always) scale/

Table 3

Means and Standard Deviations for Performance Expectations

Variable	M	SD
Interest at Conclusion	2.59	1.00
Performance	3.41	.87
Challenge	2.59	1.00

Note. Interest in the task was measured on a scale of 1 (not interested) to 3 (extremely interesting). Performance was measured on a scale of 1 (poor) to 5 (excellent). Challenge was measured on a scale of 1 (very easy) to 5 (very difficult).

Goal One: Explore the intra-individual differences between stress and everyday memory

To explore the relationship between everyday memory performance and stress hierarchical linear modeling was conducted using HLM 6.0 Student Version (Raudenbush, Bryk, & Congdon, 2000). HLM uses random-effects regression to explore relationships in nested data structures across levels. Data from the everyday memory tasks and daily stress assessments were explored at Level 1. These variables varied within individuals on a day-to-day basis across the two-week duration of the study. HLM creates a regression equation for each individual predicting the outcome variable with that person's level 1 variables. Each individual's slopes and intercept become the outcome variable at level 2. Level 2 effects explored between-person differences in single assessments of cognitive functioning to determine their relationship with stress and everyday memory. These variables were constant within the individual, but varied between individuals.

The number of openings was entered as the outcome variable in a fully unconditional model. No predictors are entered in this model, which is used to estimate the amount of variance in the dependent variable that is explained by each of the levels (Bryk & Raudenbush, 1992). For the accuracy of openings, an intra-class correlation indicated that 26% of the variability in the number of openings was between people. The remaining 74% was within-person at level one.

In order to test the relationship between the accuracy of openings and stress with basic cognitive predictors, I used the average daily stress level to predict the accuracy of openings in a two-level HLM model. Stress was entered into the model group-mean

centered. Therefore, the intercept indicated the individual's average accuracy score and the slope indicated the increase in errors for every point increase in stress. At Level 2, the cognitive predictors of speed of processing and working memory were grand-mean centered, indicating how individuals' between-person cognitive scores were related to accuracy of openings.

The results are shown in Table 3. As seen here, none of the predictors emerged as statistically significant. DSST was a marginally significant predictor of opening errors. These results suggest that an individual's stress level was not related to the accuracy of openings. Furthermore, cognitive resources were not beneficial to task performance, although higher speed of processing could potentially contribute accuracy of openings.

The second model explored the relationship between the timing of intervals and stress with basic cognitive abilities. The fully unconditional model with the correct timing of intervals entered as the outcome variable indicated that 45% of the variability was between-persons. The remaining 55% of the variability was within-persons, indicating that individuals varied more around their own averages than between-group averages.

Table 4

Two-Level Hierarchical Linear Model Predicting Accuracy of Openings

Fixed Effects	Coefficient	SE	T	df	<i>p</i>
Intercept	.58	.13	4.52	14	.00
DSST	-.03	.02	-2.09	14	.06
Listening Span	-.29	.15	-1.90	14	.08
Stress	.25	.21	1.16	232	.25
x DSST	.04	.03	1.50	232	.13
x Listening Span	-.26	.25	-1.03	232	.30

Note. Dependent variable was the number of opening errors each day. DSST = Digit symbol substitution task. The model was being tested as follows: Level 1 equation: Opening Accuracy = $\beta_{0i} + \beta_{01}(\text{Stress level}) + R$. At Level 2, each Level 1 coefficient was predicted by: $\beta_{0i} = \gamma_{00} + \gamma_{01}(\text{DSST}) + \gamma_{02}(\text{Listening Span}) + u_{0i}$, $\beta_{01} = \gamma_{00} + \gamma_{01}(\text{DSST}) + \gamma_{02}(\text{Listening Span}) + u_{0i}$. Bold type indicates statistically significant at $p < .05$.

To test the relationship of correct timing with stress and basic cognitive predictors, I used the average daily stress level to predict the accuracy of timing in two-level HLM model. Stress was entered group-mean centered at Level 1. Speed of processing and working memory were grand-mean centered at Level 2.

The results are shown in Table 5. As seen here, stress level was not statistically significantly related to the timing of openings. Speed of processing and working memory were statistically significantly associated with increased accuracy in timing. These effects are plotted in Figures 1 and 2. The cross-level interaction between speed of processing and average daily stress level was also statistically significant the relationship between stress and timing accuracy was more negative for individuals with higher, rather than lower, processing speed. This relationship is shown in Figure 3. Simple slopes test (Aiken & West, 1991) indicated that individuals with a DSST score that were one standard deviation above the mean showed performance declines with stress. Individuals who were one standard deviation below the mean improved with stress. These results suggest that speed of processing and working memory are important for maintaining correct timing of the intervals. The interaction with stress and speed of processing are not in the direction that was initially predicted, as individuals with higher cognitive resources performed worse on the task.

Table 5

Two-Level Hierarchical Linear Model Predicting Accuracy of Intervals

Fixed Effects	Coefficient	SE	T	df	<i>p</i>
Intercept	.60	.04	13.52	14	.00
DSST	.02	.00	3.21	14	.01
Listening Span	.16	.05	2.97	14	.01
Stress	-.03	.08	-.38	232	.70
X DSST	-.02	.01	- 2.49	232	.01
X Listening Span	.10	.09	1.08	232	.28

Note. Dependent variable was the proportion of correctly timed intervals. DSST = Digit symbol substitution task. The model was being tested as follows: Level 1 equation: Timing Accuracy = $\beta_{0i} + \beta_{01}(\text{Stress level}) + R$. At Level 2, each Level 1 coefficient was predicted by: $\beta_{0i} = \gamma_{00} + \gamma_{01}(\text{DSST}) + \gamma_{02}(\text{Listening Span}) + u_{0i}$, $\beta_{01} = \gamma_{00} + \gamma_{01}(\text{DSST}) + \gamma_{02}(\text{Listening Span}) + u_{0i}$. Bold type indicates statistically significant at $p < .05$.

Figure 1.

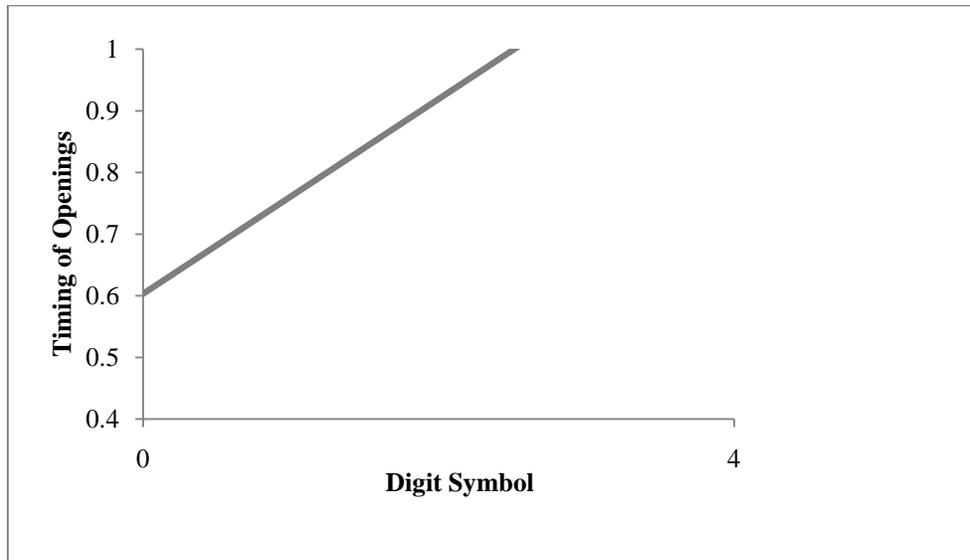


Figure 2.

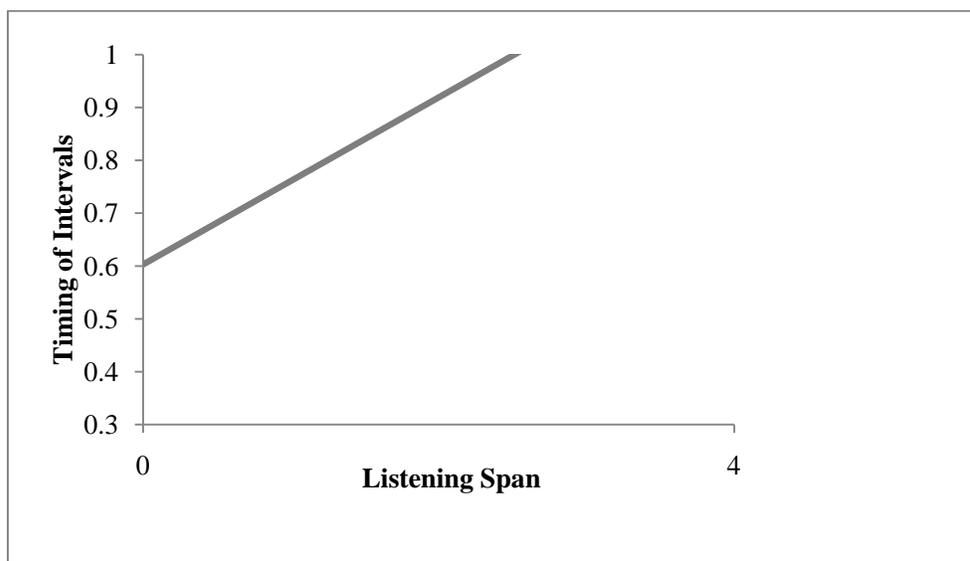
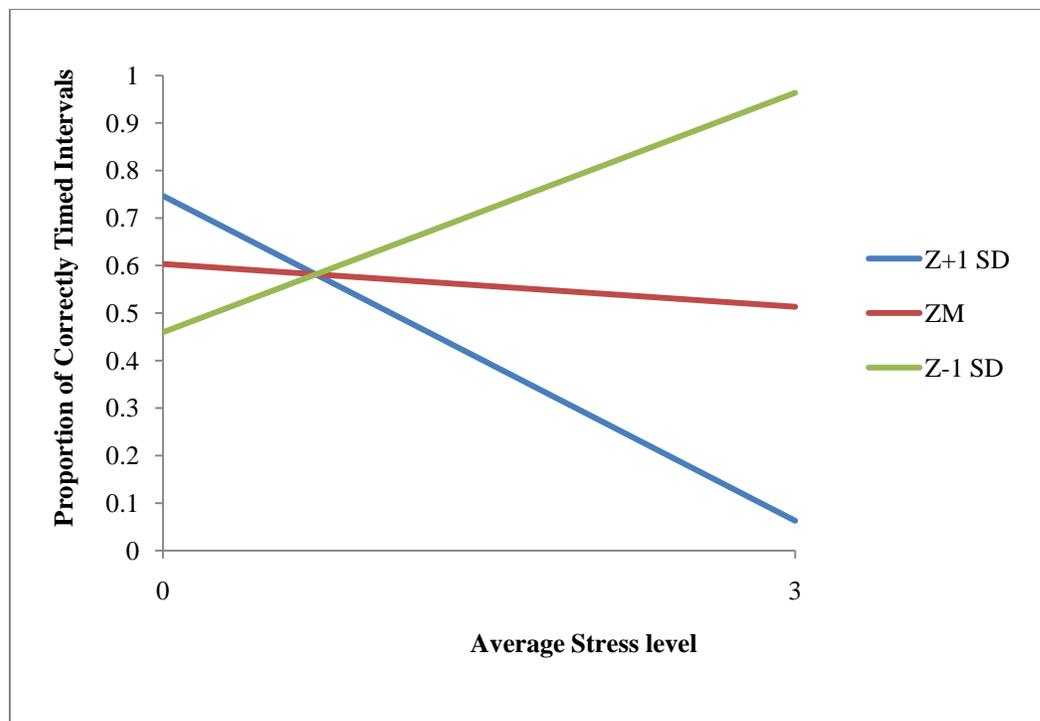


Figure 3.



Goal Two: Exploring the between-person relationship with cognitive variables and everyday memory performance

To explore how caregiver's performance on the task varied as a whole, Pearson's correlations were run to explore the mean-level differences. The bivariate relationship between the standardized memory task and the laboratory measures of cognition are useful for understanding the associations among basic cognitive abilities with the everyday memory task. This is particularly important given that the WCST was not predictive of task performance in the hierarchical linear models. For these analyses, a composite variable of the absolute difference score of the number of errors made each

day and the proportion of correct intervals were used. These correlations, shown in Table 6, indicated some statistically significant relationships among the cognitive variables with both dependent variables. The means and standard deviations for cognitive variables are seen in Table 7.

The DSST was significantly related to the timing of the intervals and the number of correct openings, indicating that those with higher speeds of processing were better able to maintain the 3-4 hour intervals between openings. The relationship between the DSST and the WCST was marginally significant, suggesting that there could be a potential relationship between executive function and speed of processing. All other correlations with the cognitive variables were non-significant. Interestingly, although there was not a main effect of stress on timing in the multilevel models (i.e., an individual's stress level did not impact their task performance), the proportion of correctly timed intervals was statistically significant to the reported stress level during the two week period meaning that higher stress was related to lower timing scores. See Table 8.

Table 6.

Correlation Matrix for Cognitive Variables

Correlations	1.	2.	3.	4.	5.	6.	7.
1. Openings	-	.77*	-.46*	.36	.12	-.26	.39
2. Timing of Intervals		-	.57*	.30	.28	-.09	.37
3. Digit Span			-	.45†	-.09	-.32	.09
4. WCST Categories				-	-.56*	-.68*	.38
5. WCST Preservative Errors					-	.81*	-.06
6. WCST Total Errors						-	-.23
7. Listening Span							-

Note. Openings and Timing are between- subject averages. There was a trend towards statistically significance with the digit symbol substitution task and the number of categories completed on the Wisconsin card sorting task. * = $p < .05$, † = $p = .06$.

Table 7

Means and Standard Deviations for Cognitive Variables

Variable	M	SD
Average Opening Errors	.58	.62
Proportion of Correct Intervals	.62	.27
Digit Symbol Score	50.11	8.47
WCST Categories Completed	5.60	11.83
WCST Preservative Errors	15.47	13.80
Listening Span	2.12	.99

Note. WCST = Wisconsin card sorting task

Table 8.

Correlations of Dependent Variables with Stress Variables

Correlations	1.	2.	3.	4.
1. Openings	-	.77*	-.12.	-.25
2. Timing of Intervals		-	-.34	-.52*
3. Number of Stressors			-	.91*
4. Stress Level				-

Note. Correlation table of stress variables with the dependant variables. * = $p < .05$

Discussion

Main Findings

The goal of the present study was to explore the impact of the stress associated with caregiving on everyday memory. This is the first study investigate how older adult caregivers perform on a life-relevant cognitive task. Cognitive resources were only marginally related to the correct number of openings each day, but speed of processing and working memory resources were vital in maintaining the more complex timing portion of the task. Stress alone did not predict performance on the pseudo-medication task, however there was an interaction with speed of processing and stress that suggests stress level can play a role in cognitive functioning.

Caregivers performed the pseudo-medication task well. For the majority of days, the medication bottle was opened the correct number of times. One of the hallmarks of this study was that the time-based and event-based component of the everyday memory task could be explored separately to determine their relationship with basic cognitive abilities. It appears that the time-based portion of the task, maintaining the correct timing of intervals, was a more demanding cognitive task. This has also been found previously in unpublished data sets using the same medication regime with non-caregivers (McDonald-Miszczak et al., 2009). Given the prospective nature of the task, it is understandable that ensuring the correct schedule of timing would be more difficult than openings. Although the pseudo-medication task is a type of everyday memory task, it relies heavily on prospective memory. Of the differing prospective memory tasks, time-based tasks are typically more difficult, as they rely on self-initiated remembering, rather

than an external event like an alarm clock. Kidder, Park, Hertzog, and Morrell (1997) found that prospective memory tasks performance decreased when working memory task increased, which is consistent with the findings in this study. It is possible that participants could also turn the time based component of the task into an event based task through the use of a strategy such as an alarm. Overall, this is consistent with Willis, Jay, Diehl, and Marsiske's (1992) work, indicating that basic cognitive abilities predicted performance on an everyday memory task. Those with more cognitive resources are better able to perform the everyday memory task, particularly when the task requires self-initiated monitoring of performance, like that of a time-based prospective memory task.

The caregivers in this study reported low levels of burden and depression. This is not entirely inconsistent with previous studies, as Vitaliano et al. (2005) found that caregivers were below clinical criteria for depression. Other researchers have also found inconsistent levels of depression in comparing older adult caregivers with similar aged non-caregivers (e.g., Vitaliano, Russo, Scanlan, & Greeno, 1996). Caregivers who feel capable in their roles have also reported fewer symptoms of distress and have described the experience as being positive (Schulz et al., 1997). Kramer (1997) argues that an increased closeness with the care recipient could also reduce the stress placed on the caregiver and could explain why stress levels were low. Although the stress level was low in this sample, it was higher than older adults who were non-caregivers in a study by Neupert, Almedia, Mroczek, and Spiro (2006) that used the same daily stress measure. Demographic questions that addressed the amount of activity in their lives also indicate that these caregivers felt some control in their daily schedule. Therefore, based on this

sample it is not possible to fully determine how stress impacted performance because these caregivers did not report high levels of stress.

Stress may still play a role in memory performance. Although stress level alone was not related to correct number of openings or the timing of intervals, the interaction of speed of processing with stress is an exciting finding. Most surprisingly, the interaction with stress opposite of what was predicted. According to the attention-depletion hypothesis, stress negatively impacts cognitive performance as thoughts associated with the stressor claim resources that could be used for other tasks (Klein & Boals, 2001). Stawski, Sliwinski, & Smyth (2006) also found that relative to younger adults, stress appeared to exacerbate normative age related declines. The same relationship of stress and cognition was not found in this study. Individuals with lower speed of processing increased the accuracy of their timing on days when their stress increased. Those that had higher speed of processing showed declines in their abilities to maintain the intervals with stress. Other researchers have suggested that some stressors are associated with an increase in cognitive performance, but this was found using different methods. Rosnick et al. (2007) detected a cognitive enhancement associated with stress by exploring the type of stressors experienced over the past year and attributed it to motivation.

Caregivers in this study with lower speed of processing may have been motivated by the stressor to perform well on the task. Baltes et al. (1998) suggest that stress can serve to activate a cognitive reserve, cognitive resources that are being unused, that allows older adults to overcome challenging situations. Caregivers with higher speed of processing scores may have already activated their cognitive reserve and are essentially

already operating at their fullest capacity. Therefore, when they experience a stressor, their performance declines because they have already expended all of their resources. Potentially, those with lower speed of processing may have not yet activated their cognitive reserve. When these caregivers experience a stressor, the stressor propels them to activate unused resources which enable them to increase their performance. In summary, individuals with higher cognitive abilities performed the task better. Future research is needed to understand what mechanisms are propelling the interaction with stress, speed of processing, and the timing portion of the task.

The second goal of the study was to explore mean-level relationships between basic cognitive predictors and the daily memory tasks. Executive functioning scores were not related to performance on the daily memory task. Although Insel et al. (2008) found that executive functioning scores predicted actual medication adherence, it did not appear to be related to this standardized task. Future research is needed to explore this relationship. This discrepancy could be reflective of the differences between taking an actual medication and pseudo-medication regimen. Although medication adherence is at least partially a cognitive task, there are other components that influence how adherent an individual is to his or her actual prescription medication (Parks and Kidder, 1996). Further, daily medication adherence is often a habitual task that is not as demanding as the pseudo-regime used in this study. Executive functioning was marginally related to working memory scores. However, working memory scores were not related to speed of processing.

The lack of relationship between speed of processing and working memory is counter to what researchers (e.g., Salthouse, 1992) have previously found. This correlation is difficult to interpret as speed of processing is proposed to be one of the processes that drive working memory ability. One of the components of working memory (processing efficacy) relies on mental processing speed. Perhaps the most likely explanation is a lack of power due to the small sample size. Given a larger number of participants, the relationship may be more easily detected. However, it is also possible that speed of processing and working memory may rely on distinct mechanisms that are related but not necessarily dependent upon one another. The differences between how speed of processing and working memory predict performance on the number of openings and the timing of the intervals supports this notion. Although speed of processing and working memory were significant within-person predictors of the timing of the intervals, only speed of processing was related to both the timing and openings when looking at between person measures. This suggests that as tasks become more difficult (requiring more mental effort), resources specifically related to working memory are necessary for successful completion of complex real life tasks. Alternatively, participants may have been discouraged by the difficulty of the listening span and not performed to their full ability. Their scores may not necessarily reflect their actual capabilities. Overall, the analyses for the second goal of the study were primarily exploratory, but indicated that speed of processing was also related to performance on the task when exploring mean-level differences.

Limitations

One limitation of the current study is that this sample may not be representative of all informal older adult caregivers. Caregivers reported low levels of stress, depression, burden, and had been caregivers for several years. They could be experiencing less stress because the duties associated with caregiving have become a normative part of their life. It is possible caregivers who felt overwhelmed by their circumstances may have been less likely to participate. This study design did involve a daily commitment for two weeks, which may have been too great for some caregivers. Although only one participant dropped out of the study, the reason given was that the daily task was too demanding. Therefore, this sample may best reflect higher functioning caregivers rather than all older adult caregivers. The correlations also need to be interpreted with the small sample size in mind. There could be restriction of range which would make some of the effects hard to detect.

Future Directions

The current investigation provides valuable insight for future studies. An increase in sample-size would allow for more statistical power and provide clarity to some of the zero-ordered correlations. Decreasing the duration of the study from two weeks to a single week could increase the likelihood of obtaining a more representative sample. If this sample is reflective of higher functioning caregivers, it would also be beneficial to determine what mechanisms set them apart. Specifically, perceptions about being a caregiver should be explored. Aldwin, Spiro, and Park (2006) argue that stress may not

be as harmful to older adults because chronic issues like caregiving become part of the “background” of daily life and may not be viewed as necessarily stressful. Perception of the stressors may be key. The socioemotional selectivity theory of aging (Carstensen, Isaacowitz, & Charles, 1999) suggests that older adults focus on the present and positive experiences better enables them to handle some of the challenging situations that occur in later life. Comparisons between new caregivers and those that are “expert” caregivers would be useful in understanding how coping skills evolve with experience. Future studies should also focus on how the task is performed successfully.

Caregivers who are able to maintain timing accuracy may report employing different strategies than those who have more difficulties with the task. It is also plausible that individuals may not be implementing one strategy, but relying on several strategies. In light of the interaction with speed of processing and stress, this may be particularly relevant. Perhaps individuals with higher speed of processing fail to utilize and develop compensatory strategies under higher levels of stress, because they feel that they can rely on their cognitive abilities. In turn, individuals with lower processing speeds may be more aware of their limitations and engage in more compensatory strategies. Finally, the role of personality factors could also be explored. Perhaps those with higher processing speeds are more reactive to stress or overconfident in their abilities.

Conclusion

This study is the first to explore how caregivers perform a relevant memory task over an extended period of time and adds to the understanding of how specific cognitive abilities predict performance to a pseudo-medication regimen. Cognitive resources are

important for everyday memory. Speed of processing and working memory resources are key in maintaining performance on a complex task. Although stress itself was not directly associated with the number of openings or the timing of intervals, the cross-level interaction with stress and speed of processing provides surprising and useful insight. Caregiving may not always be associated with cognitive decline. In terms of task performance, individuals with greater cognitive resources did better. However, these cognitive resources may not protect against a negative impact from stress. Alternatively, stress may also be a motivator for some individuals to go to greater lengths to engage their cognitive reserves

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