Normative Age-Related Individual Differences in Executive Functioning and its Impact on Quality of Life and Mood in Aging Couples

by

Jenna Dawson

A thesis
presented to the University of Waterloo
in fulfillment of the
thesis requirement for the degree of
Master of Arts
in
Psychology

Waterloo, Ontario, Canada, 2013

Author's Declaration

I hereby declare that I am the sole author of this thesis. This is a true copy of the thesis, including any required final revisions, as accepted by my examiners. I understand that my thesis may be made electronically available to the public.

Abstract

With the aging of society and increased longevity, understanding the factors that contribute to declines in quality of life and mood, such as normative health declines and cognitive declines is progressively more important. Past research has consistently demonstrated that cognitive skills decline with age; specifically, a major change associated with normative aging is a decline in executive functions (Phillips & Henry, 2008). Past research has focused on investigating how abnormal declines in cognitive and executive functioning have impacted the self and others; however a relatively unexplored issue is examining how individual differences in normative age-related changes in cognitive functioning impact the self and others. The first purpose of the current study was to investigate normative age-related differences in executive functioning skills and how these individual differences impact individuals and their marital partners. The second purpose of the current study was to investigate whether executive functioning skills in particular, rather than other domains of cognitive skills thought to be separate from executive functioning, predicted poor quality of life and mood in self and partner. Participants were 91 heterosexual couples 55 years and above who were married or cohabiting. They completed measures of quality of life and mood in addition to a variety of cognitive tasks and executive functioning tasks measuring their inhibition, working memory and task switching abilities. We found that lower executive functioning skills in one partner significantly predicted lower levels of quality of life in the other partner (partner effect). However, we found that there was no significant relationship between those with lower levels of executive functioning and one's own ratings of quality of life (actor effect). Conversely, when investigating the impact of executive functioning on mood we found that lower levels of executive functioning resulted in lower ratings of mood for the same partner (actor effect). However, lower levels of executive functioning in one partner

did not predict lower levels of mood in the other partner (partner effect). In no instance was general cognition, as assessed using tasks of language, visuospatial ability, and short-term memory, related to partner or actor effects for either outcome measure. Implications of these findings are discussed.

Acknowledgements

I would like to thank my supervisors, Dr. Uzma Rehman and Dr. Tara McAuley, for their collaboration and invaluable assistance with all aspects of this project. I would also like to thank my third reader, Dr. David Moscovitch, for providing helpful feedback on this document. I would like to acknowledge the undergraduate research assistants who helped with data collection and the lab managers of the Relationship Research Lab for their instrumental help with many administrative aspects of the data collection: Danielle Rice and Siobhan Torrie. Additionally, I like to thank Erin Fallis, Brenda Chiang, and Kassandra Cortes for their ongoing encouragement and assistance in helping me to develop my research ideas, as well as providing me feedback. On a personal note, I am very grateful for the unwavering support of my family and for their keen interest in all of my projects. Finally, I would like to thank my partner Brent Golem for his love and endless patience.

Table of Contents

List of Tables

Although considerable research has investigated age-related clinical disorders, such as Alzheimer's Disease and Parkinson's Disease (Beard, Kokmen, O'Brien, & Kurland. 1995; Evans, Funkenstein, Albert, 1989; Steadman, Tremont, Davis, 2007), there is a growing interest in expanding this focus to include not only disease processes, but to better understand what constitutes normative aging (Booth and Johnson, 1994; Hibbard and Pope, 1993). There is considerable research demonstrating that cognitive decline is part of the normal aging process. Within clinical samples, research has also demonstrated that cognitive dysfunctions may impact the self and others. However, a relatively unexplored issue is investigating how individual differences in normative age-related changes in cognitive functioning impact the self and others. To address this gap in the literature, the current study constitutes an initial step in exploring individual differences in cognitive functioning and how they relate to quality of life and mood amongst married older adults drawn from a community sample. Specifically, we will be focusing on investigating the impact individual differences in executive functioning have on both oneself and one's partner.

Executive functioning

Cognition subsumes a wide variety of specific skills. It has been found that many cognitive skills decline with age; however, the magnitude and direction of these changes vary across cognitive domains such that some skills are more vulnerable to the effects of aging than others (Morse, 1998). For example, vocabulary and general knowledge continue to improve into one's sixties and remain fairly stable thereafter (Schaie, 1994), whereas declines in memory tend to become apparent in one's sixties (Giambra, Arenberg, Kawas, Zonderman, Costa, & Paul, 1995) and speed of information processing begins to decline as early as the third decade of life (Salthouse, 1996).

There are several theories that attempt to explain causal mechanisms that contribute to age related declines in cognition (Lyon & Krasnegor, 1996). One that does so is the processing-speed theory of cognitive aging. This theory posits that a major factor contributing to age-related differences in aspects of cognitive functioning is a decline in processing speed, which is required to carry out cognitive operations (Salthouse, 1985). Processing speed represents how quickly many different types of processing operations can be carried out to complete a task (Salthouse, 1996) and thus becomes slower as tasks involve increasingly complex skills. The processing speed theory of cognitive aging suggests that processing speed slows as individuals age, which in turn hinders older adults' ability to carry out operations and results in a decline in their level of cognition.

An alternative theory is provided by the frontal hypothesis of aging. This theory, developed by Dempster (1992), focuses specifically on age-related changes in the frontal lobes and concurrent changes in executive functioning. Executive functioning is widely regarded as a set of inter-related skills that promote purposeful behaviours (Lezak, 1994). Although it is has been challenging to pin down an exact definition of the term, three skills are thought to be central to the executive contrast (Miyake, Friedman, Emerson, Witzki, & Howerter, 2000). These skills include inhibition, which is the ability to voluntarily control behaviour that conflicts with an automatic and proponent response (MacLeod, 1991; McDowd, Oseas-Kreger, & Filion, 1995), shifting, which is the ability to shift attention back and forth between multiple tasks, operations or mental sets (Rogers & Monsell, 1995), and working memory, which is the ability to maintain and manipulate information in mind for a short period of time (Baddeley, 1981; Conway, Kane, & Engle, 2003). These skills are central to theories of executive functioning (Lyon & Krasnegor, 1996). These skills are supported by distinct, though overlapping neural networks, in which

prefrontal brain regions play a particularly important role (Aron et al., 2004; Cohen et al., 1994) and are considered to be the building blocks of more complex executive tasks and other aspects of cognition (Miyake et al., 2000).

The frontal hypothesis of aging posits that as individuals grow older, they experience a weakening in their frontal lobes which form part of the neural system that supports executive skills. Research has established that the frontal lobe is one of the last regions within the brain to develop and is one of the first brain regions to show signs of deterioration in later life (Dempster, 1992). In particular, aging has been shown to correlate with decreases in the size, volume, and density of cells within the frontal lobe (Uemura & Hartman, 1978). This deterioration results in a decline in brain weight and cortical thickness in the frontal region (Haug, Knebel, Mecke, Orum, & Sass, 1981). Changes in the frontal lobes are more susceptible to age-related changes than the posterior regions of the brain that are thought to be associated with other cognitive skills (Shaw et al., 1984). For example, the degree of reduction in the temporal, parietal, and occipital regions of the brain has been estimated to be approximately 1%, compared with volume reduction in the frontal cortex estimated to be 10%-17% (Haug et al., 1983; Haug & Eggers, 1991). As such, the frontal lobe hypothesis of aging posits that cognitive functions supported by the prefrontal cortex, namely executive functions, should decline at an earlier age than those cognitive skills supported by other brain regions.

A large body of research suggests that a major change associated with normative aging is a decline in executive functions (Phillips & Henry, 2008). In one illustrative study, for example, Libon et al. (1994) compared participants aged 75 years and older with a younger age group (i.e., those 74 and younger). Comparisons showed that the older participants exhibited greater deficits in problem solving, mental flexibility, and the ability to maintain and shift mental sets. Similar

results have been reported elsewhere (Campbell, 1990; Christensen, 2001; Crawford, Bryan, Luszcz, Obonsawin, & Stewart, 2000). Although the frontal lobe hypothesis of aging posits that executive functions exhibit signs of age-related decline at an earlier age than cognitive abilities that are preferentially supported by other regions of the brain, research has demonstrated that older age is associated with significant inter- and intra-individual differences in the precise rate at which executive skills change. Although the average performance on most tasks declines with age, some studies have suggested that many older individuals change very little, whereas others may deteriorate more dramatically, leading to a greater diversity of performance-based scores (Christensen, Mackinnon, Jorm, Henderson, Scott, & Korten, 1994; Morse, 1998). For example, a study by Carlson, Xue, Zhou, and Fried (2009) examined executive functioning skills in older adults over a nine-year period. At the time of the study enrollment participants were healthy older women (age 70-80 years) who had sufficient hearing, mobility, exercise tolerance, and were capable of completing basic self-care. Over the nine-year period, the researchers found that 49% developed one or more impairments across functional and cognitive domains (e.g., self care, mobility, hearing loss, verbal knowledge). Of the 49% who developed impairments, 37% developed an impairment in executive functioning, which was measured by the Trail-Making task. Thus, although majority of those who experienced impairments did so in the domain of executive functioning, the overall percentage of participants with such impairments (i.e., 37% of 49%) constituted a minority of the sample, highlighting the fact that there are large individual differences in executive functioning among older adults.

We were interested in investigating normative differences in executive functioning above and beyond changes in other cognitive domains for a number of reasons. First, past research has found that executive functions are responsible for controlling and managing many different

cognitive domains and have the potential to affect performance on a wide variety of cognitive tasks (Salthouse, Atkinson, Berish, 2003). Second, the main components of executive functioning - namely inhibition, working memory and task switching - have played a prominent role in theories of cognitive aging (Salthouse, 2005). As mentioned previously, the frontal hypothesis of aging developed by Dempster (1992) and elaborated by West (1996) posits that age-related cognitive deficits are associated with declines in executive functions. Additionally, executive functions are essential in the completion of many important tasks including planning, problem solving, adapting to changes in the environment, coordinating multiple tasks while storing information, and shifting between stimulus and response sets. Therefore, executive functions facilitate the completion of many important daily tasks such as financial management, medication management, telephone use, shopping for necessities, managing a household, and transporting oneself within the community. Consequently if one experiences poorer executive functioning, one may have difficulty completing a variety of essential tasks that are required to be a successful, independent individual and may also have a hard time contributing to a well-functioning relationship. Further, research has shown that there is a positive relationship between executive functioning skills and completion of household tasks, above and beyond that of general cognitive abilities (Bell-McGinty, Podell, Franzen, Baird, & Williams, 2002; Jefferson, Paul, Ozonoff, & Cohen, 2006). That is, those with lower executive functioning skills have a harder time completing household tasks compared to those who have difficulties with general cognitive abilities. This lower capacity to complete everyday tasks may, in turn, negatively affect themselves as well as their partner.

One of the goals of the current study was to compare executive functioning skills with other domains of cognitive functioning to demonstrate that executive functioning differences

between individuals, in particular, are associated with lower levels of well-being both in oneself and one's partner. We contrasted executive functioning abilities with functioning in cognitive domains that are thought to be separate from that of executive functioning (i.e., language, visuospatial abilities and short term memory). These cognitive domains are important, as they comprise basic necessary skills and are often measured to assess for cognitive impairments. Moreover, they are also thought to be skills that are not associated with the frontal lobe.

The interpersonal level of analysis

To date, research on age-related normative declines in domains such as executive functioning has tended to focus exclusively on the impact of such changes on the self and has therefore lacked an interpersonal focus. Specifically, to our knowledge, there are no past studies that examine how these normative age-related changes might impact significant others in one's life. A rich literature on interpersonal theory would lead us to posit that age-related executive functioning changes in one individual would notably impact significant others. Interdependence theory suggests that individuals initiate and maintain relationships at least in part because of the benefits interactions yield within a relationship (Rusbult & Buunk, 1993; Kelley & Thubaut, 1978). These interactions yield outcomes for individuals in the forms of costs and rewards such as pleasure, gratification, distress, and pain (Rusbult & Buunk, 1993). Another central component of interdependence theory is that those in close relationships influence one another's experiences and need each other to obtain valued outcomes such as affection, emotional closeness and support. Additionally, individuals belonging to the same dyad affect one another in complex ways. Interpersonal theory maintains that the attributes of each dyad member has a direct influence on the other and plays a role in determining the outcomes for each individual

(Kelley & Thubaut, 1978). As a result, changes in the attributes of either dyad member may affect the outcome for both dyad members.

We would also expect normative lower levels of executive functioning to impact one's partner due to research surrounding equity theory. Equity theory states that people seek fairness in their social relationships (Walster, Walster & Bercheid 1978). It posits that individuals weigh the costs and rewards associated with their interactions and are more likely to continue an interaction when they find that the intrinsic rewards outweigh the costs and when they perceive that alternative social interactions would be less rewarding than the current one (Floyd & Wasner, 1994). Based on this premise, it can be assumed that dissatisfaction occurs when relationships are inequitable; that is, when people feel under-benefited or over-benefited in their social interactions. Research has shown that if someone perceives himself or herself to be under-benefitted within an interpersonal relationship that individual may experience an increase in distress and feelings of exploitation (Davidson, 1984). Conversely, if one perceives that they are over-benefited from their relationship they can experience feelings of guilt and shame. Within a normative sample, research by Davidson (1984) found that middle-aged and elderly wives who perceived the division of tasks such as cooking and housekeeping as uneven, were more depressed and dissatisfied with their roles, as compared to wives who perceived the division of tasks as equal (Davidson, 1984). Perceived inequality in decisions regarding household chores has also been found to affects husbands' satisfaction levels (Spitze, 1986). Therefore if a spouse is unable to complete tasks due to lower levels of executive functioning, it is likely that the ensuing perceptions of inequality will result in greater dissatisfaction in the partner.

In our study, we focused specifically on the marital relationship, rather than other interpersonal relationships. The rationale for examining the impact on one's marital partner is

multi-fold. The marital relationship is one of the most significant relationships of a person's life and romantic partners serve as primary attachment figures throughout adulthood (Katz, 2001). As individuals age their social circles grow smaller and their marriage often becomes the most intimate and enduring of all close relationships (Stinnett, Carter & Montgomery, 1972). Marital status has been shown to have a positive impact on quality of life and has been shown to provide important benefits such as increased emotional support, increased affective positivity and decreased health concerns (Stinnett, Carter & Montgomery, 1972; Erikson, Erikson & Kivnick, 1986; Parron, 1982). Therefore, focusing on how lower levels of executive functioning impact both partners within a marital relationship is critical.

When investigating age-related decline in executive functioning and its impact on the self and partner, past literature has tended to focus on overall cognitive decline, without consistently making distinctions between different domains of cognitive functioning. Nevertheless, we review these studies below because it informs our thinking about how cognitive changes are related to own and partner well-being, with the caveat that our study also aims to differentiate and paint a more nuanced picture of which types of normative age-related cognitive declines are particularly relevant. In addition, although our study focuses on normative processes, we review literature from clinical and subclinical samples.

Past research has found that clinical levels of cognitive dysfunction have a strong impact on one's partner's quality of life. Quality of life has been found to be lower in spousal caregivers of those with clinical levels of cognitive dysfunctions such as Alzheimer's Disease and Parkinson's Disease (Peters, Fitzpatrick, Doll, Playford, Jenkinson, 2011). Past research has also found that spousal caregivers are more likely to report mood disorders, tiredness and sadness, lower life satisfaction, and lower satisfaction with their social life, due to their caregiving role

(Peters et al., 2011). In a longitudinal study investigating the effects of caregiving on the caregiver, results showed a 63% increase in the risk of early death (i.e., those with prevalent and subclinical disease) in addition to reports of finding the experience of caregiving burdensome (Schulz & Beach, 1999). This research suggests that the impact of cognitive declines on one's partner's quality of life and mood are quite significant and can lead to significantly negative outcomes.

Further, there is also a link between subclinical levels of cognitive decline (i.e., mild cognitive impairments; MCI) and its impact on the self and others (Roberto, McCann, Blieszner, 2011). Mild cognitive impairment (MCI) is a condition in which a person experiences problems with their memory, language, or other essential cognitive abilities and may be a prodromal period between normal aging and Alzheimer's Disease (Smith, Petersen, Ronald, Parisi, & Ivnik, 1996). Blieszner and Roberto (2010) found that those with MCI have difficulty maintaining their work and household responsibilities, have a hard time engaging in personal relationships, and struggle with making decisions. Blieszner, Roberto, Wilcox, Barham, and Winston (2007) found that partners of those with MCI altered their daily activities by taking on more of the tasks that their partner used to perform and discontinuing their involvement in many social activities (Blieszner et al., 2007), which can lead to a decrease in life satisfaction and well-being. In support of this, spouses have reported a variety of role strains as a result of adapting to their partner's declines in cognitive functioning (Schulz and Beach, 1999). Thus, our aim is to expand this research by investigating lower levels of normative age-related executive functioning and its impact on quality of life and mood.

Quality of life

In our study, quality of life (QOL) was the first outcome variable that we investigated. Specifically, we were interested in examining how age-related differences in cognitive functioning are related to self-reported quality of life in both members of the marital dyad. Recently, the study of QOL in older individuals has become an increasingly popular topic due to the growing number of older adults in the population (Farquhar, 1995). QOL is an elusive concept that has proven to be difficult to define. Past researchers have measured and assessed QOL in a variety of ways depending on the context it has been used; this has resulted in inconsistencies within the research (Farquhar, 1995). Although QOL has been defined and assessed in a variety of different ways, researchers tend to agree that the optimal way to conceptualize QOL is as a multidimensional construct that includes physical, emotional and social domains (Bowling 2001; Halvorsrud & Kalfoss 2007). Physical domains consist of physical health, the ability to do things around the house and one's energy level. Emotional domains measure one's mood and one's perceptions of their life and self as a whole. Social domains capture ratings of satisfaction surrounding friendships, marriage, and leisure activities. Thus in the current study, we adopted a multidimensional conceptualization of QOL which included the physical, emotional and social domains discussed above.

Past studies have also shown that how individuals perceive their QOL, as opposed to an objective measurement of QOL, is more predictive of outcomes, given that one's feelings about one's life are intrinsically subjective (Andrews and Withey, 1976). Objective measurements of QOL are thought to be insensitive to the feelings of the individuals (Andrews and Withey, 1976), therefore one's perceptions surrounding the domains that comprise QOL are important to consider. Perceived QOL is a set of evaluations that a person makes about each major domain of

his or her life. One popular definition of QOL, proposed by the World Health Organization (1995), defines it as "the individual's perceptions of their position in life in the context of the culture and value system in which they live, and in relationship to their goals, expectations, and standards" (pp. 1). One important aspect of this definition is the focus on perceptions of well-being.

As the seniors' share of the population increases, understanding how older adults perceive their QOL is important to study in addition to investigating the factors that contribute to lower levels of QOL. Therefore, not only did we adopt a multidimensional approach when measuring QOL by asking individuals about domains such as physical health, finances, social life and functional abilities, we also asked individuals to rate their perceived satisfaction in these areas.

Mood

The second outcome variable that we were interested in investigating was mood. Depression has been found to occur in at least 8-25% of the older adults in the general population (Pimontel, Culang-Reinlieb, Morimoto, & Sneed, 2011). Depression in late life is associated with negative outcomes including increased disability and higher rates of mortality (Charney et al., 2003). Older individuals with depressive symptoms report nearly twice the functional impairment of older adults without depressive symptoms (Callahan et al., 1998). Thus, examining factors that may contribute to depressive symptoms in older adults is of critical importance. Past research has found an association between declining executive functioning and increased symptoms of depression within older adults. Research by Lockwood, Alexpoulos, and van Gorp (2002) found that the poorer one performed on the executive functioning measures (i.e., tasks measuring response inhibition, initiation, task switching, processing speed, and mental

manipulation), the higher one's ratings of depression. Thus, we were interested in expanding the research surrounding executive functioning and depression by investigating how normative age-related differences in executive functioning may impact one's own symptoms of depression as well as one's partner's symptoms of depression.

The Current Study

With the aging of society and increased longevity, understanding the factors that contribute to declines in quality of life among older adults is becoming ever more important. The current study focused on investigating normative age-related differences in executive functioning skills and how individual differences impact individuals and their marital partners. We were also interested in examining whether executive functioning skills in particular, rather than other domains of cognitive skills thought to be separate from executive functioning, predict poor quality of life and mood in both self and partner.

There are a number of ways in which the current study contributes to the existing literature. It is the first study to examine how differences in executive functioning and other domains of cognitive functioning (language, visuospatial abilities, and short term memory) that occur as part of the normal aging process predict one's own as well as one's partner's mood and quality of life. Further, we gathered data from both partners to examine our questions, allowing us to simultaneously examine the influence on self and partner. We used standardized and well-established cognitive tasks designed to tap into the key constructs of executive functioning: working memory, inhibition and task switching. We also included two outcome measures in our study, QOL and CES-D.

In light of past research, we predicted that: (a) lower levels of executive functioning will be associated with lower quality of life in self (Hypothesis 1a) and partner (Hypothesis 1b).

Further, we predict that lower levels in other areas of cognitive functioning (i.e., language, visuospatial abilities and short-term memory) will not be associated with poorer quality of life for self or partner (Hypotheses 1c & 1d). We also predict that lower levels of executive functioning will be associated with lower mood in self (Hypothesis 2a) and partner (Hypothesis 2b). We also predict that other areas of functioning such as language, visuospatial abilities and short-term memory will not be associated with lower mood in self or partner (Hypotheses 2c and 2d).

Method

We examined our research questions using data from a larger study being conducted in the Relationship Research Lab at the University of Waterloo. Detailed information about the design, participants, variables, assessment procedures and data-analytic procedures follow below.

Participants

Ninety-one couples participated in the current study as part of a larger research project examining the effects of interpersonal factors on aging couples. Couples were recruited from the Waterloo Research in Aging Participant pool (WRAP) at the University of Waterloo. This research pool is managed by researchers on the University of Waterloo campus to facilitate research in aging and consists of individuals aged 60 and over. Couples were also recruited by posters in local businesses and ads in local newspapers and radio stations.

To be eligible for the study, participants either had to be married or cohabiting for a minimum of two years. This ensured that both married and cohabiting couples were similarly committed to their relationships. Furthermore, both members of the couple had to be over the age of 55 and both members of the couple had to report being able to speak and read English at a

Grade 8 level to ensure that they would be able to accurately understand and complete all of the study measures.

All couples that participated in the study were in a heterosexual relationship. The couples that participated in the study had been in their current relationships for an average of 29.06 years (*SD* = 10.89 years). The female participants had an average age of 69.76 years (*SD* = 6.69) and had completed on average 14.38 years (*SD* = 3.79) of education. Of the female participants, 62.3% reported that their personal gross annual income fell between $20,000 and $59,999, with most of these participants (31.1%) reporting that their income fell between $40,000 and $59,999. Thirty-eight per cent reported that their income was greater than $80,000. All of the female participants identified themselves as Caucasian. The male participants had an average age of 72.82 years (*SD* = 6.21) and had completed 15.08 years (*SD* = 3.96) of education. Of the male participants, 35.9% reported that their personal gross annual income was between $5,000 and $59,999, 64.1% reported that their income was between $60,000 and $100,000, and 24.4% reported an income that was over $100,000. Among male participants, 98.9% identified as Caucasian. The remaining male participants were of African (1.1%) descent.

Measures

Background Questionnaire. This questionnaire was designed for the current study. It gathered information about participants' demographic characteristics (e.g., age, income, educational achievement) and the history of their current relationships (e.g., marital status, relationship length). Information was also gathered regarding their health history (e.g., history of past traumatic brain injury, history of stroke, history of depression).

Adapted Quality of Life Questionnaire. The Quality of Life Questionnaire used in this study was adapted from the QOL-AD (Alzheimer's Disease) scale (Logsdon, Gibbons &

McCurry, 1994). The QOL-AD uses simple and straightforward language. Responses are structured in a four-choice format, and all items are rated according to the individual's current perception of their QOL. The QOL measure used in the current research includes 13 items that measure satisfaction in the domains of family, friends, finances and life as a whole. Participants are asked to rate each factor on a 4-point scale by circling "poor", "fair", "good" or "excellent". Rather than participants filling out the questionnaire from the viewpoint of a "caregiver" as the QOL-AD suggests, the scale was adapted to ask participants to rate their perception of their own quality of life. Cronbach's alpha for the QOL-AD measure was 0.89 (Logsdon, Gibbons, McCurry, & Teri, 1999).

Depression. Symptoms of low mood were measured using the self-report Center for Epidemiological Studies Depression scale (CESD; Radloff, 1977). This instrument was designed to screen for depressive symptoms in the general population. It consists of 20 items in which participants are asked to rate how often they have felt or behaved in a specific way on a 4-point likert scale with ratings of 0 corresponding with "rarely or none of the time" and ratings of 3 corresponding with "most or all of the time". Examples of questions include, "I was bothered by things that usually don't bother me", "I felt that everything I did was an effort" and "I did not feel like eating, my appetite was poor". The CES-D has a Cronbach's alpha of .85 within the general population (Radloff, 1977).

Working Memory. The working memory variable was created as a composite score using Digit Span Backwards and Digit Span Sequencing from the Wechler Adult Intelligence Scale – fourth edition (WAIS-IV; Wechsler, 2008). The total number of digits the participants correctly recalled on both digit span backwards and digit span sequencing task were summed and contributed to their working memory composite. Higher scores indicate better performance.

In the digit span task (Wechsler, 2008), participants completed three conditions. In each condition participants heard an audio recording that presented the digits at 1,000 milliseconds per digit. Participants were then asked to repeat the digits back to the research assistant. Participants were given a practice item at the beginning of each condition in order to ensure their understanding of the rules. The first trial of each condition began with two digits. As participants progressed through the task, one digit was added to each subsequent string increasing the memory load on the participants. For the first condition, Digit Span Forwards, participants were given digits and asked to repeat them back verbatim. For the second condition, Digit Span Backwards, participants were given a series of digits and asked to repeat them back to the research assistant in reverse order. For the last condition, Digit Span Sequencing, participants were asked to mentally rearrange and sequence the digits from smallest to largest. The dependent measure of working memory was the number of digits correctly recalled in during digit span backwards and sequencing conditions. Participants discontinued the task when they provided a wrong answer on two trials in a row. Across participants aged 55 to 90 years old, the digit span backwards task has a Cronbach's alpha ranging from .77 in those aged 80-84 years to .82 in those aged 55-64 years. The digit span sequencing task has a Cronbach's alpha ranging from .79 in those aged 55-64 years to .92 in those aged 85-90 years (Wechsler, 2008).

Inhibition. Inhibition was measured using the Colour Word Interference from the Delis–Kaplan Executive Function System (D-KEFS; Delis, Kaplan, Kramer, 2001). This task is thought to tap inhibitory processes by requiring the respondent to ignore the automatic response of reading a printed word and to instead name the colour of ink in which the word is printed (Regard, 1981). Participants were given a practice item at the beginning of each condition in order to ensure their understanding of the rules. Each condition was timed. In the first condition,

participants were shown a page with a series of coloured dots. Participants were then asked to name the colour in which the dots were printed (e.g., blue, green, red, or yellow) as fast as possible. In the second condition participants are presented with a page similar to what they saw in the first condition; however the dots were replaced by the words of colours printed in black ink. Participants were asked to read the words as quickly as possible. In the third condition, participants were again presented with a sheet similar to what they saw in the previous condition; however, the colour names (i.e., blue, green, red, and yellow) were printed in lower case and in a coloured ink that was incongruent to the colour name (i.e., the word blue was printed in a yellow ink). Participants were asked to name the colour the word was printed in and inhibit themselves from reading the printed word. The dependent measure of inhibition was the time taken to complete Part C of the task. Lower scores on this task represent better performance. Across participants aged 55 to 90 years old, the colour-word interference task has a Cronbach's alpha ranging from .77 in those aged 80-89 years to .86 in those aged 50-59 years (Delis, Kaplan, Kramer, 2001).

Task Switching. The task switching variable was created as a composite score, summing the final condition from the Colour Word Interference task from the D-KEFS and the fourth condition from the Trail Making task from the D-KEFS. Lower scores represent better performance.

The final part of the Colour Word Interference task is thought to tap into switching processes by requiring the respondent to switch between established rules in a timely manner. In Part D, participants completed a task very similar to Part C. Participants were presented with a sheet filled with colour words printed in different ink colours. They were then given a set of rules to follow when completing the task. Participants were asked to read the ink colour the word was

printed in unless the word was appeared within a box, in which case, participants were asked to read the printed word, not the ink colour. Part of the dependent measure of task switching was the time taken to complete Part D of the task. The Cronbach's alpha for this task is the same as the above colour-word interference task (Delis, Kaplan, Kramer, 2001).

The Trail Making task (Delis, Kaplan & Kramer, 2001) also assesses task-switching ability by requiring participants to switch between a set of established rules. This task consists of four conditions, each of which is timed as a measure of individuals' performance. In the first condition participants were asked to scan a sheet for a specific number and cross out each one they could find as quickly as possible. This was a measure of their scanning abilities. In the second condition participants were asked to draw connecting lines to incremental numbers on a test sheet. In condition three they were asked to similarly draw connecting lines to incremental letters on a test sheet. In the final condition, participants were asked to alternate their connecting line between incremental numbers and alphabetical letters. The time taken to complete the final condition contributed to the dependent measure of task switching. Across participants aged 55 to 90 years old the trail making task has a Cronbach's alpha ranging from .60 in those aged 70-79 years to .81 in those aged 50-59 years (Delis, Kaplan, Kramer, 2001).

General Cognitive Functioning. The Montreal Cognitive Assessment measure (MoCA, Nasreddine et al., 2003) is a cognitive screening tool used to detect mild cognitive impairments. It includes measurements of visuospatial abilities, memory, attention, language and orientation. In order to assess whether the results found were specific to executive functioning abilities or to cognition more generally, subtests from the MoCA were administered. The specific subtests selected included measures of language, visuospatial abilities, and short-term memory. The first language subtest asked participants to name low-familiarity animals shown within a picture and

the second language subtest asked participants to repeat two syntactically complex sentences. The visuospatial subtest asked participants to complete a clock-drawing task and a drawing of a three-dimensional cube. Finally, the short-term memory subtest asked participants to recall five nouns after a delay of approximately 5-minutes. Participants gained points for every correct answer they provided and their performance on these subtests represented a measure of different aspects of their cognitive functioning. The total score they achieved on each subtest was summed to represent their cognitive functioning score. Higher scores represent better performance. The MoCA has a Cronbach's alpha of .83 (Nasreddine et al., 2003).

Processing Speed. A simple response task was administered to control for age-related changes in processing speed, which are known to account for some variance in age-related differences in executive functioning (Salthouse, 1996). It was included to determine whether effects related to executive functioning were significant even after age-related changes in processing speed were controlled. In this computer task participants were asked to press the space bar as soon as they saw an arrow appear on the screen. The interval between each target was not consistent; the appearance of the target was presented at variable times to measure reaction time. The time it took participants to respond to each target contributed to their processing speed score. There were 25 experimental trials within this task.

Procedures

All study measures and procedures were approved by the University Of Waterloo Office of Research Ethics. When the couples arrived at the lab, they reviewed the letter of information together with two research assistants and signed the study consent forms. Male and female partners were then separated into different rooms where they completed all questionnaires with the assistance of a research assistant. Participants began by completing the Background

Questionnaire and then completed the executive functioning measures which were administered amongst a series of questionnaires unrelated to the current research. Participants also completed the cognitive tasks thought to be unrelated to executive functioning as a comparison to investigate whether the results found on the executive functioning measures were associated with lower abilities in cognitive processes in general, or if they were specific to lower executive functioning. Participants also completed a discussion task that was unrelated to the current study. The lab session took approximately three hours to complete. When the couple completed the study, they were debriefed and were given $50.00 each and a list of health resources in appreciation for their time.

Data Analytic Strategy

The present study used a hierarchically structured design, with individuals nested within couples. Thus, the data were organized at two levels: the level of the couple or dyad and the level of the individual. Multilevel structures imply interdependence of data, which violates the assumption of standard regression procedures that observations are independent of each other. Therefore, we used mixed model regression, which enabled us to account for interdependence in the data. All measures were standardized. We also re-ran all of the analyses reported below with gender included as a covariate. When gender was included in our models, the findings did not change in direction or significance level. In addition, the pattern of results for all models included within our analysis was the same when processing speed was statistically controlled for. Thus, we are presenting the more parsimonious models here. Participant's scores that were missing data were defined as missing in SPSS (n=28). We also identified potential outliers as those who stood three standard deviations from the mean on the variables of interest. Those participants whose values were above or below three standard deviations were replaced by

their respective cut-off values (n=9).

Results

Preliminary Analyses

Sample Descriptive Characteristics. The mean scores and standard deviations of key study variables are listed in Table 1. There was a significant gender difference between males' and females' scores on the digit span sequencing task, $t(90) = 2.13$, $p = .036$ and between males' and females' scores on the trail making task – Condition 4, $t(88) = -2.24$, $p = .027$. There were no other significant gender differences found.

Correlations among Key Study Measures. The correlations among key study variables for males and females are presented in Table 2. Quality of life was significantly correlated with mood for both males and females. Additionally, working memory scores were significantly correlated with inhibition and task switching scores for both males and females and inhibition scores were again significantly correlated with their task switching scores for both males and females. Further, females' quality of life scores were significantly correlated with inhibition scores and females' mood ratings were significantly correlated with task switching scores. Males' mood scores were significantly correlated with both inhibition and task switching scores. Females' general cognitive functioning scores were significantly correlated with their own working memory, inhibition and task switching and males' general cognitive functioning scores were significantly correlated with their own quality of life, working memory and task switching scores. Last, male and female partners' scores on the QOL scale were correlated.

Executive Functioning and Quality of Life (Hypotheses 1a & 1b)

We ran separate analyses for each domain of executive functioning. Each model included one of the three measures of executive functioning (working memory, inhibition and task

switching) as the predictor variable and included both one's own score on that measure (actor effect) as well as the partner's score on that measure (partner effect). In all of these analyses, QOL was the outcome variable.

The first domain of executive functioning that we investigated included actor and partner effects for working memory. The results showed no significant association between one's own working memory and one's own ratings of QOL, $\beta = .04$, $t(156.13) = 1.06$, $p = .292$. However, there was a significant association between one's partner's score on working memory and one's own ratings of QOL, $\beta = .11$, $t(155.45) = 2.58$, $p = .011$, such that lower working memory scores in one partner resulted in lower ratings of QOL in his/her spouse.

The second model that we tested included actor and partner effects for inhibition. The results showed that there was no significant association between one's own performance on the inhibition task and one's QOL, $\beta = -0.03$, $t(161.75) = -.45$, $p = .653$. However, there was a significant association between one's partner's score on inhibition and one's own rating of QOL, $\beta = -0.19$, $t(161.30) = -2.68$, $p = .008$, such that the poorer one performs on inhibition, the lower their partner's rating of QOL.

The third and final model that we tested for this hypothesis included actor and partner effects for task switching. The results showed that there was no significant association between one's own task switching abilities and one's own QOL, $\beta = -0.05$, $t(151.19) = -1.16$, $p = .249$. However, there was a significant association between one's partner's score on task switching and one's own QOL, $\beta = -0.13$, $t(152.27) = -3.07$, $p = .003$, such that the poorer one performs on task switching, the lower their partner's QOL.

Alternative Cognitive Functioning Domains and Quality of Life (Hypotheses 1c & 1d)

To test the link between own and partner general cognitive functioning and QOL, we

used the same model as described above. In the first analysis one's own scores on the cognitive functioning composite (actor effect) and one's partner's scores on the cognitive functioning composite (partner effect) were the predictor variables and QOL was the outcome variable. As predicted, there was no significant association between one's own cognitive functioning scores β = .10, $t(144.37) = 1.33$, $p = .184$ or one's partner's scores on cognitive functioning on one's own quality of life, β = .08, $t(145.94) = 1.03$, $p = .306$.

Executive Functioning and Mood (Hypotheses 2a & 2b)

To test our second hypothesis investigating the effects of executive functioning on mood we ran separate analyses for each domain of executive functioning and used CES-D as the outcome variable. The first domain of executive functioning that we explored was working memory. The results showed that there was a significant association between one's own working memory and one's own mood, β = -.10, $t(161.60) = -2.39$, $p = .018$, such that the lower one's working memory scores, the lower their own mood ratings. However, there was no significant association between one's own score on working memory and their partner's rating of mood, β = .12, $t(178.61) = .28$, $p = .781$.

The second model that we tested included actor and partner effects for inhibition. The results showed that there was a significant association between one's own inhibition scores and one's own ratings of mood, β = .18, $t(162.43) = 2.40$, $p = .017$, such that the poorer one scored on the inhibition task, the lower their own ratings of mood was. However, there was no significant association between one's score on inhibition and their partner's ratings of mood, β = .06, $t(165.05) = .77$, $p = .440$.

The third and final model that we tested for this hypothesis included actor and partner effects for task switching. The results showed that there was a significant association between

one's own task switching scores and one's own ratings of mood, β = .17, $t(169.45) = 4.06$, $p = .000$, such that the worse one scored on task switching, the lower their own mood ratings. However, there was no significant association between one's score on task switching and their partner's ratings of mood, β = .01, $t(162.60) = .31$, $p = .754$.

Alternative Cognitive Functioning Domains and CES-D (Hypotheses 2c & 2d)

To test the link between own and partner general cognitive functioning and ratings of mood, we used the same model as described above. In the first analysis own scores on the cognitive functioning composite (actor effect) and partner scores on the cognitive functioning composite (partner effect) were the predictor variables and mood was the outcome variable. As predicted, there was no significant association between one's own scores on cognitive functioning scores β = -0.05, $t(154.21) = -.723$, $p = .471$ or one's partner's scores on cognitive functioning on mood, β = -0.03, $t(178.15) = -.647$, $p = .647$.

Table 1. *Means and standard deviations for men's and women's scores on study measures.*

Measure	Males	Females
Quality of Life	27.19 (4.49)	26.86 (4.52)
Center for Epidemiological Studies - Depression	7.76 (6.59)	8.77 (8.02)
Backwards Digit Span	7.63 (2.64)	8.12 (2.35)
Digit Span Sequencing	8.09 (2.44)	8.74 (1.99)
Colour-Word Interference – Condition 3	72.72 (22.50)	68.92 (21.84)
Colour-Word Interference – Condition 4	75.94 (24.75)	76.98 (28.46)
Trail Making Task – Condition 4	104.24 (36.39)	92.37 (37.89)
MoCA – Cognitive Functioning	10.91 (2.35)	12.00 (1.84)
Working Memory Composite	15.71 (4.35)	16.86 (3.76)
Task Switching Composite	180.02 (52.78)	169.35 (54.69)
Simple Response Time	342.10 (76.16)	350.26 (69.03)

Table 2. *Correlations among men's and women's scores on study measures.*

	QOL	CES-D	WM	Inhibition	Task Sw.	MoCA
QOL	.422**	-.425**	.073	.084	.020	.221*
CES-D	-.426**	.046	-.197	.258*	.329**	-.186
WM	.131	-.183	.099	-.320**	-.434**	.444*
Inhibition	-.221*	.126	-.334**	.180	.554**	-.090
Task Sw.	-.194	.257*	-.460**	.603**	.055	-.245*
MoCA	-.023	.104	.260*	-.337**	-.365**	.056

Note. QOL = Quality of Life; CES-D = Center for Epidemiological Studies – Depression; WM = working memory; Task Sw = Task Switching. Correlations between males' scores appear above the diagonal, correlations between women's scores appear below the diagonal, and correlations between men's and women's scores on the same measure appear on the diagonal.

* *Correlation is significant at the* .05 level, (2-tailed).

** Correlation is significant at the .01 level, (2-tailed).

Discussion

The current study was designed to investigate the impact of lower levels of executive functioning that occur as part of the normative aging process on both members of a dyad. The first purpose of the current study was to determine how lower levels of executive functioning in one partner might impact his or her own quality of life and mood. The second purpose of the current study was to investigate how lower levels of executive functioning in one partner might impact their partner's quality of life and mood. We also wanted to examine whether it is executive functioning skills per se, rather than processing speed or cognition more generally, that relate to well-being in self and partner.

In order to determine how executive functioning affected quality of life in both dyad members we asked both partners to complete a variety of measures assessing core aspects of executive functioning (i.e., working memory, inhibition and task switching) and to report on their perceptions of their own quality of life. We hypothesized that lower levels of executive functioning would be associated with lower quality of life in the self and partner. These hypotheses were partially supported. Consistent with our first hypothesis, we found that lower levels of working memory, inhibition and task switching in one partner predicted lower levels of quality of life in the other partner (partner effect). However, in contrast, we found that there was no significant relationship between lower levels of working memory, inhibition and task switching and one's own ratings of quality of life (actor effect). In no instance was general cognition, as assessed using tasks of language, visuospatial ability, and short-term memory, related to partner or actor effects for either outcome measure. Further, this pattern of findings remained unchanged even when processing speed was statistically controlled.

In order to determine how executive functioning affected mood in both dyad members, we

compared their performance on executive functioning tasks to self-report ratings of their own mood. We hypothesized that lower levels of executive functioning would be associated with lower mood in the self and partner. These hypotheses were partially supported. We found that those with lower levels of working memory, inhibition and task switching reported having lower levels of mood (actor effect). In contrast however, we found that one's performance on executive functioning tasks did not predict one's partner's level of mood (partner effect). In addition, we also found that there was no significant relationship between other cognitive functioning skills and levels of mood in either partner, illustrating that there is something specific to executive functioning when examining its impact on mood in the dyad. These results were consistent across all executive functioning tasks and were unchanged even when processing speed was statistically controlled.

Taken together, these findings illustrate that lower levels of executive functioning that occur as part of the normative aging process impact both members of the marital dyad, albeit in different ways. Our results consistently show that individual differences in executive functioning predict one's partner's quality of life, though not one's own quality of life, whereas the opposite pattern is obtained when examining the impact of executive functioning on mood. Our results further demonstrate that these findings hold even after controlling for the possible influence of processing speed and taking into account more global aspects of cognition, thus establishing that there is something specific to executive functioning that impacts quality of life and mood.

Past research on clinical and subclinical deficits in executive functioning guided our hypothesis surrounding executive functioning and quality of life. These studies illustrated the significant impact that executive dysfunctions can have on the interpersonal relationship,

particularly in the form of lower levels of life satisfaction in the care-giving partner (Peters et al., 2011). Interestingly, we found that these lower levels in life satisfaction, or quality of life in the partner, may precede sub-clinical or clinical levels of executive dysfunction given that we found this pattern of results in those with normative age-related lower levels of executive functioning. Contrary to our findings for the partner, we did not find that lower levels of executive functioning in self to be related to lower levels of own quality of life. It is possible that those who have lower executive functioning skills do not experience a decrease in their quality of life because their partner is successfully managing the items being asked about in the quality of life measure. For example, this measure asks how participants feel about their living situation, how they feel about their current situation with money, and how they feel about their relationships. It could be that these couples are not experiencing dissatisfaction in these areas because their partner is managing the responsibilities well and taking care of everything. Research on subclinical levels of executive functioning deficits has found that it is not uncommon for caregivers to take on more responsibilities around the household (Blieszner, 2007). When considering equity theory, it posits that equity is considered to lie in the eye of the beholder; therefore it can happen that one partner may not perceive inequality within the relationship, and this could be especially true if the partner has a lower level of executive function. Similarly, equity theory also suggests that dissatisfaction can occur when relationships are inequitable, that is, when people feel under-benefited in their social interactions (Walster, Walster & Bercheid 1978). Therefore it is possible that partners of those who have lower executive functioning may have lower levels of quality of life due to an imbalance in their relationship.

When looking at the impact of executive functioning on mood, we found the predicted actor effect, such that individuals with lower levels of executive functioning skills also reported

lower levels of mood. This is important considering that depressive symptoms in late life are associated with negative outcomes including increased disability, higher rates of mortality and report greater functional impairments (Charney et al., 2003, Callahan et al., 1998). Partners who have lower executive functioning may be aware that they are experiencing more difficulties than they used to, which can negatively impact their mood. This result is also important given past research on marital distress and depression which has shown that depression can lead to increased marital distress which in turn can contribute to the development and maintenance of depression (Beach & O'Leary, 1993). Therefore, there are important implications within a relationship that can result from one partner experiencing mood difficulties. Given that caregivers experience higher levels of depression and increased mood disorders, we were surprised to find that within our sample there was no significant association between executive functioning and partner's mood ratings. It is possible that mood difficulties may become more apparent when one's partner is experiencing greater difficulties with their executive functioning than normative lower levels of executive functioning, as was seen in those with spouses who had clinical and subclinical levels of deficits. These greater difficulties may cause the partner to feel more burdened in addition to their already lower level of quality of life, leading the partner to report greater mood difficulties.

It is also interesting to note that our results supported our hypothesis regarding the uniqueness of executive functions vis-à-vis quality and life and mood relative to other cognitive skills. This was supported by our finding that executive functioning, but not cognition more generally, had a negative impact on partner-ratings of quality of life and self-ratings of lower mood. Given that our results also did not change when we controlled for processing speed strengthens our findings that there is something specific to executive functioning abilities above

and beyond that of other cognitive domains. Our hypothesis was informed by past research that has found that executive functions are essential in the completion of many important tasks and has a stronger impact on essential tasks such as household responsibilities above and beyond other aspects of cognition (Bell-McGinty, et al., 2002). Therefore, it is likely that lower levels of executive functioning are particularly salient to oneself and one's partner.

To our knowledge, ours is the first study to examine the impact of individual differences in key executive skills on aspects of well-being in a normative sample of older adult couples. Much of the existing research has examined either age-related changes in specific executive skills at the individual level or the impact of declining executive skills in clinical and subclinical populations. Our results provide support for interpersonal theory which posits that the attributes of each dyad member has a direct influence on one another and plays a role in determining the outcomes for each individual (Kelley & Thubaut, 1978). As we discovered, this is true when investigating the impact of executive functioning on older individuals. In terms of application, these results can help to develop and tailor interventions designed to help older couples transition through the aging process. Past research has found an association between abnormal cognitive functioning and lower levels of quality of life and mood. Our results however, indicate that declines in quality of life and mood occur when there are normative age-related lower levels of cognitive functioning. This suggests that declines in quality of life and mood may proceed abnormal cognitive functioning and occur as one experiences normative age-related changes in their cognitive functioning. Therefore special attention should be focused on the aging population to provide resources and support in order to help prepare for these changes effectively.

It is also important to note some of the limitations of our study, which need to be kept in mind when interpreting the results. Our sample was relatively homogenous in terms of education

and ethnic background. Consistent with the population of the Kitchener-Waterloo region, our sample was primarily Caucasian. Additionally, our sample reported a relatively high monetary income, which may not be fully representative of the current population. It is possible that our results will not generalize to individuals and dyads from other cultures, ethnicities or socioeconomic status. However, it is important to note that based on norms developed on the D-KEFS and WAIS-IV, the current sample performed in the normative range on executive functioning tasks. Therefore participants' performance on these tasks should be considered generalizable to their same-age community peers.

Another limitation of this study is that the design was exclusively correlational; therefore, we cannot attribute causation or direction to our results. Based on past research, we hypothesize that declines in executive functioning precede declines in mood and quality of life. However, an alternative interpretation of our results is possible; namely, that lower levels of quality of life and mood may result in lower levels of executive functioning. Owing to the cross-sectional design of our study, age-related changes in the constructs of interests could not be investigated. As such, one area of future research that would be beneficial is to conduct a longitudinal study investigating executive functioning over a period of time to explore these declines and the impact they have on mood and quality of life.

References

Andrews, F., & Withey, S. (1976). *Social indicators of well-being: americans' perceptions of life quality*. Plenum, New York.

Aron, A, R., Monsell, S., Sahakian, B, J., Robbins, T. (2004). A componential analysis of task-switching deficits associated with lesions of left and right frontal cortex. *Brain: A Journal of Neurology,* 27(7),1561-1573.

Baddeley, A. (1986). Working memory. New Oxford University Press, NY.

Beard, C, M., Kokmen E., O'Brien P, C., & Kurland L, T. (1995). The prevalence of dementia is changing over time in Rochester. *Neurology*, Minnesota. Neurology. 45(1), 75-79.

Bell-McGinty, S., Podell, K., Franzen, M., Baird, A., & Williams, M. (2002). Standard measures of executive function in predicting instrumental activities of daily living in older adults. *International Journal of Geriatric Psychiatry*, 17(9), 828-834.

Blieszner, R., & Roberto, K. A. (2010). Care partner responses to the onset of mild cognitive impairment. *The Gerontologist*, 50, 11–22.

Blieszner, R., Roberto, K. A., Wilcox, K. L., Barham, E. J., & Winston, B. L. (2007). Dimensions of ambiguous loss in couples coping with mild cognitive impairment. *Family Relations*, 56, 195–208.

Booth, A., & Johnson, D. (1994). Declining health and marital quality. *Journal of Marriage and the Family*, 56(1), Feb 218-223.

Bowling, A. (2001). *Measuring disease: a review of disease specific quality of life measurement scales*. 2nd edn., Open University Press, Philadelphia

Callahan M., Wolinsky, D., Stump, E., et al. (1998). Mortality, symptoms, and functional impairment in late-life depression. J Gen Intern Med 13: 746–752.

Campbell, J., Charness, N. (1990). Age-related declines in working-memory skills: Evidence from a complex calculation task. *Developmental Psychology,* 26(6), 879-888

Carlson, C, M., Xue, Q., Zhou, J., & Fried, P, L. (2009). Executive decline and dysfunction precedes declines in memory: The Women's Health and Aging Study II. *The Journals of Gerontology: Series A: Biological Sciences and Medical Sciences,* 64A(1), 110-117.

Charney, S., Reynolds, F., Lewis, L., et al. (2003). Depression and Bipolar Support Alliance consensus statement on the unmet needs in diagnosis and treatment of mood disorders in late life. *Arch Gen Psychiatry* 60, 664–672.

Christensen, H. (2001). What cognitive changes can be expected with ageing? *Australian and New Zealand Journal of Psychiatry*, 35, 768-775.

Christensen, H., Mackinnon, A. J., Jorm, A. F., Henderson A. S., Scott, L. R., Korten, A. E. (1994). Age differences and interindividual variation in cognition in community-dwelling elderly. *Psychology and Aging*, 9, 381–390.

Cohen, J. D., Forman, S. D., Braver, T. S., Casey, B. J., Servan-Schreiber, D., & Noll, D. C. (1994). Activation of the prefrontal cortex in a nonspatial working memory task with functional MRI. *Human Brain Mapping, 1*, 293-304

Conway, A., Kane, M, J., & Engle, R. (2003).Working memory capacity and its relation to general intelligence. *Trends in Cognitive Sciences*, 7(12), 547-552.

Crawford, J., Bryan, J., Luszcz, M., Obonsawin, M., Stewart, L. (2000) The executive decline hypothesis of cognitive aging: Do executive deficits qualify as differential deficits and do they mediate age-related memory decline? *Aging, Neuropsychology, and Cognition,* 7(1), 9-31.

Davidson, B. (1984). A test of the equity theory for marital adjustment. *Social Psychology Quarterly, 47,* 36-42.

Delis, D., Kaplan, E., Kramer, H. (2001). *Delis-Kaplan Executive Function System (D-KEFS): Examiner's manual.* San Antonio, TX: The Psychological Corporation

Dempster, F. (1992). The rise and fall of the inhibitory mechanism: Toward a unified theory of cognitive development and aging. *Developmental Review*, Vol 12(1), 45-75.

Erikson, E. H., Erikson, J., & Kivnick, H. (1986). *Vital involvement in old age.* New York: Norton

Evans D, A., Funkenstein H, H., Albert M, S., et al. (1989). Prevalence of Alzheimer's disease in a community population of older persons: Higher than previously reported. *Journal of the American Medical Association*. 262, 2551-2556.

Farquhar M. (1995). Elderly people's definitions of quality of life. *Social Science Medicine*, 41(10), 1439–1446

Floyd, F., & Wasner, G. (1994) Social Exchange, Equity, and Commitment: Structural Equation Modeling of Dating Relationships. *Journal of Family Psychology*, 8(1), 55-73.

Giambra, M, L., Arenberg, D., Zonderman, B, A., Kawas, C.; Costa Jr., & Paul, T. (1995). Adult life span changes in immediate visual memory and verbal intelligence. *Psychology and Aging*, 10(1),123-139.

Halvorsrud, L., Kalfoss, M. (2007). The conceptualization and measurement of quality of life in older adults: a review of empirical studies published during 1994–2006. *Journal of Aging,* 4, 229–246

Hibbard, J., & Pope, C. (1993). The quality of social roles as predictors of morbidity and mortality. *Social Science & Medicine*, Vol 36(3), 217-225.

Haug, H., Knebel, G., Mecke, E., Orun, C., & Sass, N-L. (1981). The aging of cortical Cytoarchitectonics in the light of stereological investigations. In Eleventh international congress of anatomy: *Advances in the morphology of cells and tissues* (pp. 193-197). New York: A. R. Liss.

Haug, H., Barnwater, U., Eggers, R., Fischer, D., Kuhl, S., & Sass. N. L. (1983). Anatomical changes in aging brain: Morphometric analysis of the human prosencephalon. In J. Cervois-Navarro & H. I. Sarkander (Eds.), *Brain aging: Neuropathology and neuropharmacology. Vol. 21: Aging.* New York: Raven Press.

Haug, H., & Eggers, R. (1991). Morphometry of the human cortex cerebri and corpus striatum during aging. *Neurobiology of Aging, 12,* 336-338.

Jefferson, A., Paul, R., Ozonoff, A., & Cohen, R. (2006). Evaluating elements of executive functioning as predictors of instrumental activities of daily living (IADLs). *Archives of Clinical Neuropsychology*, 21(4), 311-320.

Katz J. (2001). Self-verification theory: Expanding current conceptualizations of the link between marital distress and depression. In Beach, Steven R. H. (Ed), *Marital and family processes in depression: A scientific foundation for clinical practice.* , (pp. 111-127). Washington, DC, US: American Psychological Association.

Kelley, H. H., & Thibaut, J. W. (1978). *Interpersonal relations: A theory of interdependence.* New York: Wiley.

Libon, D., Glosser, G., Malamut, B., Kaplan, E., Goldberg, E., Swenson, R., Prouty, L. (1994). Age, executive functions, and visuospatial functioning in healthy older adults. *Neuropsychology*, 8(1), 38-43.

Lezak, M. D. (1995). *Neuropsychological assessment*. New York: Oxford University Press

Lockwood, K, A., Alexopoulos, G, S., van Gorp, W, G. (2002). Executive dysfunction in geriatric depression. *American Journal of Psychiatry* 159, 1119–1126.

Lyon, R., Krasnegor, N. (1996*) Attention, memory, and executive function.* Baltimore, MD, US: Paul H Brookes Publishing

MacLeod, C. M. (1991). Half a century of research on the Stroop effect: An integrative review. *Psychological Bulletin, 109 (2),* 163–203.

McDowd, J., Oseas-Kreger, D. M., & Filion, D. L. (1995). Inhibitory processes in cognition and aging. In F. N. Dempster & C. J. Brainerd (Eds.), *Interference and inhibition in cognition* (pp. 363–400). San Diego, CA: Academic Press.

Miyake, A., Friedman, P, N., Emerson, M., Witzki, A., & Howerter, A. (2000). The unity and diversity of executive functions and their contributions to complex "frontal lobe" tasks: A latent variable analysis. *Cognitive Psychology*, 41(1), 49-100.

Morse C. K. (1998). Does variability increase with age? An archival study of cognitive measures. *Psychology and Aging,* 8, 156–154.

Nasreddine, Z., Phillips, N., Bedirian, V., Charbonneau, S., Whitehead, V., Collin, I., Cummings, J., Chertkow, H. (2005). The Montreal Cognitive Assessment: A brief screening tool for mild cognitive impairment. *Journal of American Geriatrics Society,* 53, 695-699.

Parron, E. M. (1982). Golden wedding couples: Lessons in marital longevity. *Generations, 7,* 14-1

Peters, M., Fitzpatrick, R., Doll, H., Playford, D., & Jenkinson, C. (2011). Does self-reported well-being of patients with Parkinson's disease influence caregiver strain and quality of life? *Parkinsonism & Related Disorders*, 17(5), 348-352.

Phillips, H., & Henry J. (2008). *Adult aging and executive functioning.* In: Anderson, V. (Ed); Jacobs, R. (Ed); Anderson, P. (Ed). Executive functions and the frontal lobes: A lifespan perspective. Neuropsychology, neurology, and cognition., (pp. 57-79). Philadelphia, PA, US: Taylor & Francis.

Pimontel, M., Culang-Reinlieb, M., Morimoto, S., Sneed, J. (2011). Executive dysfunction and treatment response in late-life depression. *Int J Geriatr Psychiatry*, 27, 893–899.

Roberto, K., McCann, B., Blieszner, R. (2011). Trajectories of care: Spouses coping with changes related to mild cognitive impairment. *Dementia* 12(1) 45–62.

Rogers, R. D., & Monsell, S. (1995). Costs of a predictable switch between simple cognitive tasks. *Journal of Experimental Psychology: General, 124,* 207–231.

Rusbult, C., & Buunk, B. (1993). Commitment processes in close relationships: An interdependence analysis. *Journal of Social and Personal Relationships*, 10(2), 175-204.2

Salthouse, T. A. (1985). *A theory of cognitive aging*. Amsterdam: Elsevier Science.

Salthouse, T. (2005). Relations Between Cognitive Abilities and Measures of Executive Functioning. *Neuropsychology*, Vol 19(4), 532-545.

Salthouse, T. (1996). The processing-speed theory of adult age differences in cognition. *Psychological Review*, 103(3), 403-428.

Salthouse, T., Atkinson, T., & Berish, D. (2003). Executive Functioning as a Potential Mediator of Age-Related Cognitive Decline in Normal Adults. *Journal of Experimental Psychology: General*, 132(4), 566-594.

Schaie, K. W. (1994). The course of adult intellectual development. *American Psychologist*, 49(4), 304-313.

Schulz, R., & Beach, S. R. (1999). Caregiving as a risk factor for mortality: The caregiver health effects study. *Journal of the American Medical Association*, *282*, 2215–2219.

Shaw, T. G., Mortel, K. F., Meyer, J. S., Rogers, R. L., Hardenberg, J., & Cutaia, M. M. (1984). Cerebral blood flow changes in benign aging and cerebrovascular disease. *Neurology*, 34, 855-862.

Smith, G., Petersen, Ronald C., Parisi, J., & Ivnik, R. (1996). Definition, course, and outcome of mild cognitive impairment. *Aging, Neuropsychology, and Cognition,* 3(2), 141-147.

Spitze, G. 1986. The division of task responsibility in U.S. households: Longitudinal adjustments to change. *Social Forces,* 64 689-701.

Steadman, P, L., Tremont, G., & Duncan Davis, J. (2007). Premorbid Relationship Satisfaction and Caregiver Burden in Dementia Caregivers. *Journal of Geriatric Psychiatry and Neurology*, 20(2), 115-119.

Stinnett, N., Carter, L. M., & Montgomery, J. E. (1972). Older persons' perceptions of their marriages. *Journal of Marriage and the Family, 32,* 428-434.

Uemura, E., & Hartman, H. A. (1978). RNA content and volume of nerve cell bodies in human brain. I. Prefrontal cortex in aging normal and demented patients. *Journal of Neuropathology and Experimental Neurology*, 37, 487-496.

Walster, E., Walster, G. W., & Berscheid, E. (1978). *Equity: Theory and research.* Boston: Allyn & Bacon.

West, R. (1996). The application of prefrontal cortex function theory to cognitive aging. *Psychological Bulletin,* 120(2), 272-292.

Wechsler, D. (1981). *Manual for the Wechsler adult intelligence scale revised*. New York: The Psychological Corporation

WHO-QOL. (1995*). World Health Organization Quality of Life-100*. Geneva: World Health Organization, Division of Mental Health; Report No.: 100.

Appendix A

QOL (Self)				
Interviewer administer according to standard instructions. Circle responses.				
1. Physical health.	Poor	Fair	Good	Excellent
2. Energy.	Poor	Fair	Good	Excellent
3. Mood.	Poor	Fair	Good	Excellent
4. Living situation.	Poor	Fair	Good	Excellent
5. Memory.	Poor	Fair	Good	Excellent
6. Family.	Poor	Fair	Good	Excellent
7. Marriage.	Poor	Fair	Good	Excellent
8. Friends.	Poor	Fair	Good	Excellent
9. Self as a whole.	Poor	Fair	Good	Excellent
10. Ability to do chores around the house.	Poor	Fair	Good	Excellent
11. Ability to do things for fun.	Poor	Fair	Good	Excellent
12. Money.	Poor	Fair	Good	Excellent
13. Life as a whole.	Poor	Fair	Good	Excellent

Comments:_____
_____
_____

Appendix B

CESD Scale

Circle the number of each statement, which best describes how often you felt or behaved this way – DURING THE PAST WEEK. Please choose only one response per item.

	Rarely or none of the time (Less than 1 day)	Some or a little of the time (1-2 days)	Occasionally or a moderate amount of the time (3-4 days)	Most or all of the time (5-7 days)
DURING THE PAST WEEK:				
1. I was bothered by things that usually don't bother me	0	1	2	3
2. I did not feel like eating; my appetite was poor	0	1	2	3
3. I felt that I could not shake off the blues even with help from my family or friends	0	1	2	3
4. I felt that I was just as good as other people	0	1	2	3
5. I had trouble keeping my mind on what I was doing	0	1	2	3
6. I felt depressed	0	1	2	3
7. I felt that everything I did was an effort	0	1	2	3
8. I felt hopeful about the future	0	1	2	3
9. I thought my life had been a failure	0	1	2	3
10. I felt fearful	0	1	2	3
11. My sleep was restless	0	1	2	3
12. I was happy	0	1	2	3

13. I talked less than usual	0	1	2	3
14. I felt lonely	0	1	2	3
15. People were unfriendly	0	1	2	3
16. I enjoyed life	0	1	2	3
17. I had crying spells	0	1	2	3
18. I felt sad	0	1	2	3
19. I felt that people disliked me	0	1	2	3
20. I could not get “going”	0	1	2	3