Older Adults' Divergent Production in Open-Ended Everyday Problem Solving Tasks

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Honors Thesis

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OLDER ADULTS' DIVERGENT PRODUCTION IN OPEN-ENDED EVERYDAY PROBLEM SOLVING TASKS

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Using age relevant, and open-ended every day problem solving tasks (OEDT), this study analyzed elders' divergent production of responses to these tasks and their association with neuropsychological measures of executive functioning and self reported measures of daily living. This was a secondary data analysis study. Coding systems were created and implemented to measure the divergent production dimensions of fluency, flexibility, and originality on the OEDT for n=91 participants aged 65 and older. Fluency was measured via the number of safe and effective solutions generated by each participant. Flexibility was assessed with the number of different coping styles used by participants in generating their responses (more coping styles represented greater flexibility) Originality was measured using the median inverse of solution frequency type (i.e., less commonly mentioned solutions received higher originality scores). The study had three aims. The first aim investigated whether age, education and gender were related to the three divergent production dimensions, and found that age was a significant predictor of OEDT fluency. The second aim examined whether the OEDT divergent production dimensions were related to traditional psychometric and neuropsychological measures of cognition. After controlling for age/education/gender, there were, in general, no significant residual associations between measures of any neuropsychological construct and fluency/flexibility/originality, with

the exception of a single unique association between a verbal fluency composite and OEDT fluency. Aim 3 sought to investigate whether, as in previous studies, divergent production (especially fluency) in everyday tasks might predict significant additional variance in a compose measure of self-reported daily living function, above and beyond traditional neuropsychological measures. Hierarchical regressions found that three blocks of predictors were significantly associated with everyday function (demographics, memory and language, executive function), but that the OEDT divergent production measures did not explain additional variance beyond these traditional measures. Discussion focuses on the implications of the study findings, including whether divergent production measures should be associated with convergent production measures, whether self-reported measures of daily living functioning represent good measures of everyday competence, and whether the positively selected sample employed in the current study adequately represented the theoretical range of competence in the parent older adult population.

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List of Figures

List of Tables

Table of Contents

CHAPTER 1 STATEMENT OF THE PROBLEM

Statement of the Problem

The "classic pattern" of intellectual aging is one of gains and losses, preserved versus vulnerable cognitive functioning. In advanced age (e.g., after age 80), even relatively preserved areas of cognitive functioning (like verbal ability) seem to evince normative decline (Baltes, 1997; Cornelius, 1984; Schaie, 2005). The largely unanswered question, however, is whether this apparent "decline" translates to compromised everyday function. Salthouse (1990), for example, identified the "paradox" of cognitive aging, which asks how performance in daily tasks can appear to be relatively preserved for most older adults in the face of widespread normative decline in underlying neurocognitive performance?

Arising from such paradoxical observations, for the past four decades, some investigators have been asking whether traditional psychometric and neuropsychological measures of cognition represent adequate assessments of elders' everyday competence outside of the laboratory, in everyday life. (Denney, 1989; Wagner, 1986; Willis & Schaie, 1986). A chief concern has been whether traditional psychometric measures take into account the benefits of experience that older adults may bring to tasks that they are familiar with (Wagner, 1986; Willis, 1996; Willis & Schaie, 1986). Everyday cognitive challenges experienced by older adults also have motivational relevance that may affect how much effort they are willing to expend with the task (Cornelius, 1984). Thus, a number of tasks have been developed to assess how older adults solve problems in the context of everyday life (Allaire & Marsiske, 2002; Cornelius & Caspi, 1987; Denney, 1989; Diehl et al., 2005; Willis & Marsiske, 1990; Thomas, 2015).

In this study, we consider an aspect of everyday production that has received relatively little attention, divergent production. Widely discussed in the psychological literature on

creativity, *divergent production* is a concept first introduced by Guilford (1956), who defined it as the thought process or method of generating creative ideas through exploring many possible solutions. In contrast, *convergent production* is a method or process of following a particular set of logical steps to find a single "correct" solution. Furthermore, *Ill-defined problems* are problems that are not well structured and do not have a single correct answer as opposed to *well-defined problems*, which have a single correct answer (Reitman, 1965; Simon, 1973). The ability to solve ill-defined problems is associated with the concept of divergent production, which is closely associated with creativity. Creativity is defined in many different ways, which will be outlined later, but for this study I will use the term divergent production to describe creative output.

Conceptually, Simonton has argued that divergent production measures are relevant to creativity under a "constant probability of success model"; that is, the more ideas one *can* generate, the more likely one of those ideas is to be "creative". Marsiske and Willis (1998) argued that the same concept could be applied to everyday problem solving tasks; that is, the more solutions one *can* generate to everyday problem, the more likely one is able to find an effective solution when actually confronted by such a problem. Indeed, such logic was the basis for a fluency-based scoring of everyday tasks first proposed by Denney and colleagues (Denney, Pearce & Palmer, 1982; Denney & Pearce, 1989)

Standardized tests exist to assess divergent production, but similarly to executive functioning, the problems these measures present are not particularly focused on common, relevant, or important everyday tasks. Divergent production has been categorized as a component of fluid intelligence (Cattell & Horn, 1971) which is more sensitive to cognitive aging, and which is differentiated from crystallized intelligence, which is thought to be relatively preserved

with advancing age, in part because of its greater reliance on education and accumulating life experiences. Despite potential age-related losses in fluid abilities, older adults may be expected to have preserved functional competence due to their greater amount of procedural experience and knowledge in certain familiar tasks (Baltes, 1993). Thus, it has been argued that one might expect to have reduced negative age-associated differences in everyday cognitive tasks relative to traditional neurocognitive tasks (Cornelius & Caspi, 1989; Denney & Pearce, 1989), although evidence has been mixed in this regard (e.g., Willis & Schaie, 1986)

Studies have found associations between divergent production measures and executive functioning, but there is relatively little recent investigation (Guilford 1956; Cattell & Horn, 1971; Gilhooly, Fioratou, Anthony, & Wynn, 2007; Benedek, Franz, Heene, & Neubauer, 2012; Beaty, Silvia, Nusbaum, Jauk, & Benedek, 2014). Research suggests that using open-ended and age relevant tasks to measure daily functioning abilities (Allaire & Marsiske, 2002; Denney, 1989) confers two benefits: (a) it produces a clear pattern of individual differences in everyday problem solving that is related to individual differences in psychometric and neuropsychological measures of cognition, and (b) it contributes positively to the ability to predict individual differences in everyday function, above and beyond psychometric and neuropsychological measures of cognition. Thus, the purpose of this study is to determine how older adult's divergent production performance on open-ended everyday problem solving tasks is associated with traditional measures of executive functioning and measures of daily functioning in a sample of community dwelling older adults.

The present study seeks to expand upon research related to older adults' performance on complex everyday cognitive tasks. This study uses data collected by Kelsey Thomas in her dissertation titled *Understanding Errors in Complex Everyday Cognitive Tasks In Older Adults*,

also known as *Characterization of Elderly on Daily Activities in the Real World* (CEDAR). Using age relevant, and open-ended everyday problem solving tasks that Thomas created called the *Open-Ended Decisions Tasks*, this study seeks to analyze the divergent production of responses to these tasks and their association with psychometric and neuropsychological measures of executive functioning and self reported measures of daily living.

In the original CEDAR study, Thomas measured fluency, or the number of viable solutions generated, in the Open-Ended Decisions Tasks, but never conducted specific data analysis on these tasks or compared them to other measures in her study. The present study will further expand scoring of these tasks into the Guilford-inspired subcategories of fluency, originality, and flexibility, to better align OEDT performance with conventional multi-dimensional views of divergent production (Guilford 1956). Torrance (1977) also identified fluency, originality, and flexibility as key components of creative production, and thus incorporated these dimensions in his widely used Torrance Tests of Creative Thinking (Torrance, 1981). Research by investigators in our laboratory have found fairly consistent evidence negative age differences and age-related decline in everyday problem solving, but most of this work has been conducted with *convergent* production tasks (i.e., well defined problems that tended to have one correct answer; (Allaire & Marsiske, 2002; Marsiske & Margrett, 2006; Marsiske et al, 2013; Thomas & Marsiske, 2014, 2015; Willis, Jay, Diehl, & Marsiske, 1992; Willis & Marsiske, 1991; Yam, Gross, Prindle & Marsiske, 2014). With regard to more ill defined and open ended problems, evidence for negative age effects has been weaker, showing little or no age association (Marsiske & Willis, 1995), but unique predictive associations with everyday tasks (Allaire & Marsiske, 2002).

An intended contribution of the current study is to provide additional evidence regarding the problem solving performance of older adults on common everyday problems that do not have a single correct solution, and which thus encourage participants to generate a larger number of potential solutions. We believe contributions of this work will also include providing psychometric information on scoring methods to reliably assess divergent production in everyday tasks. Our hope is that this study will bridge gaps in our understanding of relationships between divergent production ability, neurocognitive function (especially executive function), and everyday competence in older adults. The study aims to achieve these contributions by means of three specific aims:

Specific Aims and Hypotheses

Aim 1: Determine if any apparent age, gender or educational differences exist in older adults' divergent production.

Hypothesis 1: There will be a negative correlation between divergent production and age, and a positive correlation between years of education and divergent production.

Aim 2: Examine relationships between traditional neuropsychological measures of executive functioning (EF) dimensions in older adults and their divergent production dimensions on the Open-Ended Decisions Tasks.

Hypothesis 2: Higher scores on EF measures, which include working memory, switching, fluency, planning, inhibition, and reasoning, will correlate to higher overall scores on the Open-Ended Decisions Tasks. In particular, there will be a strong correlation between EF fluency and Open-ended Decisions Tasks fluency.

Aim 3: Determine if relationships exist between the dimensions of the Open-Ended Decisions Tasks (fluency, flexibility, and originality) and well-defined, self-reported measures of functional activities of daily living.

Hypothesis 3: There will be positive relationships between scores on the Open-Ended Decision Tasks and scores on the self-rated Instrumental Activities of Daily Living (IADLs) and Pfeffer Functional Activities Questionnaire (FAQ). In other words, individuals that demonstrate higher divergent production will also show higher levels of everyday competence and well-being.

CHAPTER 2 INTRODUCTION

Introduction

Literature Review

Cognitive Aging

With the number of Americans over 65 projected to more than double in the next forty years (Vincent, 2010), it will be increasingly important to understand the cognitive changes that accompany aging. Cognitive changes are a normal process of aging characterized by changes both in physical structure of the brain and ability to carry out various functions (Joaquin & Gollapudi, 2001; Drag & Bieliauskas, 2009; West, 1996). Examples of cognitive ability include processing speed, attention, memory, language, visuospatial abilities, and executive functioning/reasoning. All of these cognitive abilities are important for everyday functioning such as comprehending, remembering, and making decisions regarding medical information, for example (Razani et al., 2007; Cahn-Weiner, Boyle, & Malloy, 2002).

To explain age related gains and losses, Cattell and Horn (1971) described the more "biologically based" *fluid intelligence,* which includes pattern recognition, abstract reasoning, and problem solving, and "culturally based" *crystallized intelligence*, which encompasses the use of skills, knowledge, and experience. In one study, crystallized abilities remain stable or gradually increase at a rate of 0.02 to 0.003 standard deviations per year through the sixth and seventh decade of life (Salthouse, 2012). In contrast, fluid abilities, which includes the domain of executive functioning, peak in the third decade of life and decrease at an estimated rate of -0.02 standard deviations per year (Salthouse, 2012). Another study found that in general, intellectual and cognitive abilities remain stable until individuals are between 60 to 70 years old (Giambra et al., 1995; Singer et al., 2003), which is followed by normative accelerated decrease in fluid

abilities with advancing age, as people transition from young-old (65-75 years old) to old-old (75+ years old) ages.

Fluid intelligence is rooted in executive functioning abilities, which are a set of mental skills, localized in the frontal lobe, that support the planning, organization, and completion of tasks (McCabe, Roediger, McDaniel, Balota, & Hambrick, 2010; Alvarex & Emory, 2006) . The "frontal aging hypothesis" suggests that frontal lobes are particularly sensitive to the aging process and that declines in frontal efficiency can account for many of the cognitive deficits associated with cognitive aging (Drag & Bieliauskas, 2009; West, 1996). The relationship between executive functioning and frontal lobe integrity is well established (Smith & Jonides, 1999; Alvarez & Emory, 2006; Yuan & Raz, 2014). Age related decrements are often found on tasks assessing executive functioning processes such as planning, inhibition, set-shifting, and verbal fluency (Rodriguez-Aranda & Sundet, 2006; Spieler, Balota, & Faust, 1996; van Hooren et al., 2007; Brink & McDowd, 1999). It is presumed that daily functioning relies, in large part, on the functioning of the underlying neurocognitive substrate. To that end, an implied rationale for the study of cognitive aging is to provide insight into the underlying neural and cognitive basis for effective everyday performance.

Years of Education and Everyday Problem Solving Tasks

Despite these potential age-related losses in fluid cognitive abilities, older adults may be expected to have preserved functional competence due to their greater amount of procedural experience and knowledge in certain familiar tasks (P. Baltes, 1993). In real-world contexts, older adults can draw on experience and practice to inform their problem solving (Berg & Klaczynski, 1996; Blanchard-Fields & Chen, 1996; Cornelius & Caspi, 1987; Wagner, 1986; Willis, 1996b; Willis & Schaie, 1986). P. Baltes suggests that individuals with more experience-

based knowledge, greater expertise in language, and those with greater educational achievement may have better preserved functional competence. Furthermore, Denney describes how everyday problem solving tasks differ from novel problem solving tasks, writing that "traditional problems tend to measure general problem solving *ability*, everyday problems tend to measure *ability plus experience*" (Denney, 1989, p. 46). Thus, years of education may be a predictor of performance on everyday problem solving tasks. Currently more literature is needed that analyzes the influence of years of education on open-ended everyday problem solving task performance designed for older adults that emphasizes divergent production.

Divergent Production

Creativity is an asset to problem solving because it allows for the generation of new ways of approaching an old problem. Creativity has many definitions, most of which emphasize novelty or new understanding. After reviewing a corpus of creativity articles, Plucker, Beghetto, and Dow (2004) proposed definition "Creativity is the interaction among aptitude, process, and environment by which an individual or group produces a perceptible product that is both novel and useful as defined within a social context" (p. 90).

The concept of creativity is broad; therefore many different tests have been developed to distinguish between creative people/output and non-creative people/output. Many of these have included tests of divergent thinking, self-reported creative ideation, or personality tests. The present study focuses exclusively on divergent production. *Divergent thinking* refers to the cognitive processes that help one produce multiple responses to open-ended questions or problems. *Divergent production* then is what is produced or recorded by a test of divergent thinking. In contrast, *convergent thinking* refers to the cognitive process that helps one produce

one or very few possible solutions to a given problem (Kaufman, Plucker, and Baer, 2008), and has been thought to characterize most neurocognitive tasks (Guilford 1956)

The concepts of divergent and convergent thinking were first developed by J.P. Guilford and built upon by Ellis Paul Torrance to create one of the first, and most widely used standardized measurement of creativity, the Torrance Tests of Creative thinking (TTCT). The TTCT involves tests of divergent thinking and problem solving skills. Responses on the TTCT are sub scored into *fluency*, the number of safe and effective solutions, *flexibility*, the number of different response categories answers fall into, *originality*, the relative uniqueness of responses, and elaboration, or the addition of details to an idea (Torrance, 1977). A fourth concept, elaboration, is a relatively subjective concept. In the TCCT, the elaboration subscore exists only for visual drawing tasks; therefore, elaboration is less consistently seen in the creativity literature. In counterpoint to the way "everyday" creativity will be approached in the current study, traditional TCCT tasks meant to be novel, and describe fictional scenarios and scenes not encountered everyday.

Divergent Production and Age: Divergent thinking is widely considered an essential component of creativity, and differences in divergent production have been theorized to explain the decline in creative contributions after middle age (Lehman, 1953). For instance, Guilford (1967) reviewed a number of cross-sectional studies revealing a decline in flexibility, fluency, and originality after the age of 30 or 40. In a cross-sectional, longitudinal, and cross-sequential analysis of a variety of divergent thinking tasks, McCrae, Arenberg, and Costa's (1987) results demonstrated a significantly negative correlation between age and six divergent thinking tasks. In their cross-sectional results, they found curvilinear associations between measures of fluency and age, while the relationship between age and originality was negative and linear. After a six-

year re-test period, the youngest age groups showed increases in the divergent thinking tasks, while those in the oldest groups declined. With regards to flexibility, the Seattle Longitudinal Study found negative trends for all flexibility measures with increasing age (Schaie, 1983). Cross-sectional findings reveal a linear, negative trend for all flexibility measures, with a peak performance observed in the late twenties and early thirties. Motor Cognitive Flexibility, or the ability to change response set, did not show a significant shift towards rigidity until age 81 (Schaie, 1983). The findings above suggest that with increasing age, there is a decrease in all three sub-categories of divergent production, fluency, originality, and flexibility.

Divergent Production and the Brain: The Dual Processing Model of creativity states that original ideas are a product of an interaction between systems that generate ideas and systems that control and evaluate these ideas (Finke et al., 1992; Martindale, 1999). A study assessing the neural basis of divergent thinking with an emphasis on originality, found that while completing the Alternate Uses Task (participants have to list as many uses for a brick as they can in a time interval), there was more activity in regions of the default mode network (DMN). The DMN is mainly comprised of the posterior cingulate cortex (PCC), medial prefrontal cortex (mPFC), and angular gyrus. The DMN is shown to be active when the brain is at wakeful rest such as when daydreaming and mind wandering with un-focused attention on the outside world. It is also active when someone is thinking about themselves, others, remembering past events, and planning for the future. The DMN is so called because it is the network activated "by default" when someone is not actively involved in a task. In Mayseless's study, the medial prefrontal cortex (mPFC) and the posterior cingulate cortex (PCC) were especially active during the Alternative Uses Task. The mPFC has been associated with decision-making (Fleck et al., 2006), and executive control (Alvarex and Emory, 2006). Furthermore, the PCC area is

important for memory retrieval (Cabeza, 2008). Additionally, individuals who created more original ideas exhibited more activation in the ventral anterior cingulate cortex (vACC) coupled with activity in the left occipital-temporal area (Mayseless, Eran & Shamay-Tsoory, 2015). Aligned with the results of this study, the DMN is a network that has been repeatedly associated with creativity (Gusnard & Raichle, 2001; Jung et al., 2013; Raichele and Snyder, 2007). In summary, the DMN serves to inhibit the retrieval of common ideas to allow for more remote associations leading to greater originality. The neuropsychological findings above help confirm the Dual Processing Model of creativity (Fink et al., 2010).

Divergent Production and Everyday Problem Solving: *Practical creativity* is defined as the fluent, flexible, and original generation of solutions to real world problems (Marsiske & Willis, 1998). Practical creativity is especially useful for a.) Novel or unfamiliar situations, b.) Previously unsuccessful solutions, c.) Problems without useful sources for an answer, and d.) When solutions that were once useful, prove unviable at one's present age and ability level (Marsiske & Willis, 1998). The Four C Model of Creativity theorizes four types of creativity, "Big-C" being eminent creativity usually exemplified by a well known figure who significantly impacted their field, "little-c" refers to everyday creativity, "mini-c" manifests in intentional personal creative thoughts or insights, and "Pro-c" is creativity at a professional level (Kaufman & Beghetto, 2009). Practical creativity deals with the domain of little-c and unlike the others, is applicable to daily functioning and thus is the focus of the current study. Current popular measures of divergent production such as the Torrance Test of Creative Thinking (TTCT) and the Alternative Uses Task are not practical for solving real world problems. In turn, many measures of everyday problem solving are not conducive to or do not have a consistent scoring system in place to measure divergent production.

Link Between Executive Functioning and Divergent Production

Executive functioning is a set of cognitive processes, which include attention control, inhibitory control, working memory, cognitive flexibility, reasoning, problem solving, and planning and are localized in the frontal lobe of the brain (Balota, & Hambrick, 2010; Alvarez & Emory, 2006). In the last few decades, tests have been developed to assess abilities in these specific executive domains (Inhibitory control, DKEFS color-Word Interference Test, Delis, Kaplan, & Kramer, 2001; Working memory, Digit Span Backward, Weschsler, 1997; Flexibility or switching, Trail Making Test Part B, Reitan, 1992; Reasoning, Word Series, Gonda & Schaie, 1985; Fluency, Controlled Oral Word Association Test COWA, Benton et al., 1994; Planning, DKEFS Tower Test (Denis, Kaplan, & Kramer, 2001).

To date, possibly owing in part to relatively less recent research attention to divergent production, there have been relatively few studies that explicitly addressed the relationship between executive functioning and divergent production. With decreases in executive functioning as a component of cognitive aging, it's crucial to understand how these losses affect older adults' abilities to generate divergent ideas and solve complex problems of everyday living. Additionally, if excellent divergent production abilities could help preserves everyday functioning in later life, older adults may be able to stay independent longer.

The relationship between divergent production and executive switching seems to be inherent in how divergent production is defined and measured. For instance, the subcategory of flexibility in divergent production tests is known as the ability to switch between modes of thinking when solving a problem (Torrance, 1974). Cognitive flexibility is the ability to think flexibly and form relationships between differing ideas, and it has a well-established association with divergent production (Baird et al., 2012; Jarosz et al., 2012; Kim et al., 2007; May, 1999;

Vartanian, 2009). Surprisingly, one study found that a switching task did not predict divergent production (Benedek, Sommer, Arendasy, & Neubauer, 2014). Possibly due to what may be seen as an obvious association, there is little research on the correlation between the executive component of switching and divergent production.

Early concepts of divergent production have described it as a lack of cognitive and behavioral inhibition (Martindale, 1999) and some suggest that decreased filtering of task-irrelevant information allows for more potentially divergent products (Caston, Peterson, & Higgins, 2003). Some researchers, however, view response inhibition as beneficial to divergent production in that it inhibits common automatic responses in favor of producing more novel responses. For instance, studies that directly measure inhibition ability using the Stroop task show a positive correlation between inhibition, also defined as cognitive control, and divergent thinking (Edl, Benedek, Papousek, Weiss, & Fink, 2014; Golden, 1975). Aging negatively effects response inhibition (Berkowitz & Ansari, 2008).

Another source of age related cognitive slowing has been linked to an increase in distractibility (Lusting, Hasher, & Tonev, 2006). Because many theories link disassociated attention to divergent production, Kim and colleagues (2007) examined if relative to young people, older adults may have an advantage in a divergent thinking task, the Remote Association Task (RAT). The experiment was designed to include primers disguised as "distractor words" that would help one solve the problem. Interestingly, distraction did indeed benefit the older adults who scored slightly higher on the RAT task than the younger adults who showed no benefit from the distractions in the task (Kim, Hasher, & Zacks, 2007). The role of attention in the creative process has long been debated in the creativity literature (Vartanian, 2009). Early researchers argued that creative people have the stable trait of defocused attention allowing them

to attend to differing concepts at the same time (Eysenck, 1995; Kasof, 1997; Mendelson, 1976). More recent research suggests that successful problem solving is likely a result of flexible attention in relation to task demands (Vartanian, 2009).

In addition to attention control, working memory has been associated with divergent production. Two studies reported positive correlations between working memory and divergent production tasks (de Dreu et al., 2012; Oberauer et al., 2008). In a study using a brainstorm task, working memory was positively associated with fluency and average originality (de Dreu e al., 2012). Benedek and colleagues (2014b) measured divergent thinking with an Alternate Uses task. Both working memory and inhibition significantly predicted divergent thinking, but executive switching did not. Interestingly, working memory showed a slightly higher association with the Alternate Uses Test of divergent thinking than inhibition or switching. Working memory is related to control of attention, which requires the active assessment of task-relevant information and a controlled search from memory (Unsworth & Engle, 2007). Working memory is very sensitive to cognitive aging and may help explain why older individuals do not perform as well on tests of divergent thinking.

Verbal fluency is also an executive functioning task that has particular sensitivity to cognitive aging. In this task, participants are asked to generate as many words as possible based on a category such as animals, known as semantic fluency, or based on words beginning with a given letter, known as phonemic fluency. The generation of novel, but not of old, ideas in a verbal divergent thinking task were associated with letter fluency performance implying a higher involvement of executive processes in the generation of novel ideas (Benedek et al., 2014b). The previously mentioned study replicated findings that verbal divergent production is generally associated with strong activation in the left inferior frontal gyrus (IFG) with deactivation in the

right temporoparietal junction (TPJ) (Abraham et al., 2012; Benedek et al., 2013; Fink et al., 2009). The IFG is known to be involved in general semantic processing and has been especially associated with verbal fluency (Binder et al., 2009; Constafreda et al., 2006).

Executive abilities requiring a speeded motor component are particularly susceptible to age (Simonton, 1999), and it should be noted that many tests of divergent thinking as well as tests of executive functioning are timed. For instance, verbal fluency, which is the ability to generate words for a certain category such as letters or animal names, in one minute, show decline with aging (Raichle, 2001, Mayseless, 2015). To summarize, divergent production's relation to specific executive functioning tasks are sparse, but tend to suggest that decline in executive functioning and decline in divergent production go hand in hand.

Though studies have shown a significant relationship between executive functioning and functional abilities (McAlister & Schmitter-Edgecombe, 2013; Schmitter-Edgecombe & Parsey, 2014), many of these studies are broadly focused on executive functioning, or only measured one component of executive functioning. Therefore, there is a need for more component specific analyses of executive functioning as it relates to everyday functioning and problem solving in older adults. It is difficult to determine if executive functioning drives divergent production, however, studies indeed demonstrate overlapping cognitive components such as attention control, cognitive flexibility, fluency, inhibition, and working memory.

Link Between Executive Functioning and Daily Living

The ability to function independently such as preparing meals, taking medication, and managing finances, is determined by different social, physical, emotional, and cognitive factors. Studies show however, that cognition is the strongest predictor of everyday functioning in healthy older adults (Cahn-Weiner, Malloy, Boyle, Marran, & Salloway, 2000; Farias et al.,

2009). Executive functioning is a domain that has been most consistently able to predict both self-or informant-reported Activities of Daily living (ADLs) and Instrumental Activates of Daily Living (IADLs) functioning (Cahn-Weiner, Boyle, & Malloy, 2002; Cahn-Weiner et al., 2007; Marcotte, Scott, Kamat, & Heaton, 2010; Royall et al., 2007). Specifically, one study found that task switching had a strong and significant relationship with performance-based, but not self reported IADLs in healthy older adults (Vaughn and Giovanello, 2010). Also using measures of executive subcomponents with healthy older adults, another study found a composite measure of inhibition was the greatest predictor of performance-based measures of IADLs (Han, 2010). In other words, executive functioning is crucial for daily living and complex daily tasks have the hallmark components of executive function (Marsiske & Margrett, 2006; Willis et al., 1998).

Everyday Problem Solving and Divergent Production

There is a need for divergent thinking tests that are relevant to age and to daily life so that aspects of these tests may be applied to the lives of those being studied (Marsiske & Willis, 1993). Established divergent thinking tasks such as the Torrance Test of Creative Thinking and the Alternative Uses Task are ill-defined and successful in measuring divergent production but are not relevant to everyday problems solving. Ill-defined tests of everyday problem solving such as Practical Problems (PP) and the Everyday Problem Solving Inventory (EPSI) are age relevant and applicable to daily life, but do not have scoring systems in place to determine all three established components of divergent production. A distinction is made in problem solving literature between the theoretical approaches of *well-defined* problems and *ill-defined* problems (Reitman, 1965; Simon, 1973). As noted earlier, well-defined problems are problems that are well structured and often have a single correct answer**.** The ability to solve such problems is associated with *convergent thinking*, or the ability to come up with a single, well-established

answer to a problem, and does not require significant creativity (Guilford, 1967). Ill-defined problems are problems that are not well structured and do not have a single correct answer. In other words, they are open-ended. The ability to solve such problems is associated with the concept of *divergent thinking*, or the ability to come up with many possible solutions to a given problem, and is more closely associated with creativity.

Recent research suggests that successful problem solving is likely a result of flexible attention in relation to task demands (Vartanian, 2009). This means that when the task is ill-defined and ambiguous, attention is less focused and processing is slower. When a task is well-defined and unambiguous, attention is focused and processing speed is faster (Vartanian, 2009). These findings may support why fluency, or the number of valid responses to a divergent thinking task, is often a primary factor in divergent production studies. Individuals with flexible attention are able to adjust attention to align with the structure of the problem at hand (Gihooly, Fiortou, Anthony, and Wynn, 2007).

One study explored the age differences of performance on ill-defined practical everyday problem solving in individuals between the ages of 20 and 80. Performance on these practical problems that adults may encounter in their daily lives, were found to increase with age up to the 40 and 50 year old groups and then decrease thereafter (Denney & Palmer, 1981). A second study was conducted to assess performance on three sets of ill-defined everyday practical problems, a set that young adults may encounter, a set that middle-aged adults may encounter, and a set that older adults may encounter. The results suggested that older adults were not able to outperform young and middle aged adults even on problems specifically relevant to them (Denney, Pearce, & Palmer, 1982). These findings of lower average scores on ill-defined problems in the older population are likely due to cognitive aging. Furthermore, research on

problem solving across the lifespan demonstrates a decrease in performance on traditional problem solving tasks (Botwinick, 1984; Denney 1982). These findings have been criticized, however, because such traditional problem solving tasks are largely well-defined, were not created with older adults in mind, and have not been validated in older adults (Denney & Pearce, 1989).

Finally, measures of everyday problem solving abilities have indeed been found to correlate with standard tests of functional daily living abilities. ADLs and IADLs are older adult specific questionnaires inquiring about functional abilities of everyday living in a number of domains. Poon et. al. (1992) reported a significant relationship between an ill-defined assessment of everyday problem solving, similar to the Open-Ended Decisions Tasks, and self-reported IADLs competence. Additionally, Marsiske (1992) found that self and external ratings of IADLs competence were significantly related to well-defined and ill-defined problem solving measures.

Scoring Issues in Everyday Problem Solving

Even among well-known studies analyzing ill-defined everyday problem solving tasks among older adults, there has been a lack of consistency in scoring methods of such tasks. For instance, Denney and Pearce's (1982) study scored responses to their Practical Problems (PP) test based only on fluency, or the number of safe and effective responses produced. In Cornelius and Caspi's Everyday Problem Solving Inventory (EPSI) test, judges rate how effective they believed response to be for each problem described, as well as sub categorizing responses into four response codes which were created based on previous studies of practical problem solving (Denney & Palmer, 1981) and coping with real-life stressors (Billings & Moos, 1981; Lazarus & Folkman, 1984). These response modes are 1.) Problem-focused action, 2.) Cognitive problem analysis, 3.) Passive-dependent behavior that attempts to avoid or withdraw from a situation, and

4.) Avoidant thinking and denial that includes attempts to control the meaning of a situation through cognitive avoidance (Cornelius & Caspi, 1987).

Marsiske and Willis (1993) pulled from these established tests and scoring methods to determine fluency, originality, and flexibility scores of previously established tasks of everyday problem solving (Practical Problems Test, Denney & Pearce, PP, 1989; Everyday Problem Solving Inventory, EPSI, Cornelius & Caspi, 1987; Everday Problems Test, EPT, Marsiske & Willis 1993). As mentioned earlier, fluency is a common subcategory scored in divergent thinking tasks. Fluency is best conceptualized under the constant-probability-of-success model of creative productivity, which suggests that the more ideas one generates, the higher probability they have of generating creative ideas (Simonton, 1984). Flexibility is closely related to divergent production because a flexible individual is able to overcome restrictions and devise other means of solving a problem if their original solutions proved to be ineffective (Guilford, 1970). Finally, originality captures the novelty of an idea typically by assessing how uncommon a given response is compared to responses by the majority.

Although the factors of divergent production are largely agreed upon, the means of scoring them are not. Lack of consistency in measurement and scoring has limited our understanding of how everyday problem solving and divergent production manifest in late life. That limitation has inspired this study.

CHAPTER 3 METHODS

Methods

Participants

Participants were recruited for the CEDAR study by Kelsey Thomas and Michael Marsiske. Participants were drawn largely from the Village Retirement Community, but with additional participants recruited from the larger Gainesville community through senior centers, health outreach organizations, preexisting registries, and classified ads. The University of Florida Institutional Review Board approved the Informed Consent form prior to any data collection (Protocol #2014-U-0580). Participants were not compensated, although they were offered feedback (i.e., relative standing, and whether any causes for concern were noted) on their cognitive and everyday functioning performance at the end of the study (Thomas, 2015).

Potential participants were contacted by telephone prior to scheduling the first session. During the call, they were informed about the purpose of the study, the commitment, and the inclusion/exclusion criteria (described below). If a potential participant was interested, a first appointment was scheduled where they were consented and the initial screening was completed. Prior this appointment, the participant was notified to bring his or her glasses and hearing aids if needed, and was screened for acceptable vision in order to complete the tasks during the first session.

Inclusion Criteria: Participants were screened for the following criteria before they were accepted to participate in the study to ensure that they met age requirements and understood the time commitment. Additionally, they were screened for functional vision and hearing to ensure they would be able to complete the tasks required for the study.

a.) 65 years of age or older

b.) Corrected near visual acuity of 20/80 or better, as assessed by a Good-Light Sloan Letter near vision eye card, which required participants to read increasingly small letters that were held 16 inches from their face.

c.) Had minimal hearing complaints or had hearing aid, if needed (Do you feel you have a hearing loss that causes you extreme difficulty with ordinary conversations in slightly noisy environments?)

d.) Were willing to commit to 2 sessions of 2-3 hour duration.

Exclusion Criteria: Participants were excluded if their impairment was significant enough to affect their ability to complete the requirements of the study. The purpose of excluding participants who have received cognitive testing in the last 6 months is to minimize the possible effect of increased scores due to task familiarity.

a.) During the consenting process, the consenter's subjective rating that the participant has substantial impairment in either expressive communication or in their ability to understand others, as assessed by interviewer using brief communication assessment after consenting.

b.) Have had cognitive testing within the last 6 months.

Measures

The measures from Thomas's study being analyzed in this Goldman 2017 thesis study are shown in Table 1 and further described below:

Everyday Problem Solving and Divergent Production

Open-Ended Decisions Task: This task was created by Thomas to assess practical creativity and decision making on open-ended age-relevant problems. The task consists of two scenarios in which the participant is asked (1) to explain aloud how they would make a decision on which television set to buy, and (2) which medical treatment option to choose if given

multiple choices for each. Responses to these problems were recorded and de-identified (Thomas, 2015).

Table 1

OEDT Questions

Question 1A: First, I want you to please tell me what type of factors or features Ms. Jones should consider when choosing a new television.
Question 1B: Alright, so now you have laid out several things that you would consider, so if you had several television models to choose from, what would be the next steps in narrowing down the televisions, and how would you decide and make your final choice.
Question 2A: So first tell me which questions she should ask her doctor when choosing a treatment option.
Question 2B: Alright, now that you have laid out questions you would ask, if you had multiple treatment options, what would be the next step in narrowing down the treatment options, and how would you ultimately decide on the best choice?

Self-Reported Measures of Daily living

Instrumental Activities of Daily Living (IADL): The IADL is used to assess independent living skills and functional abilities in older adults. The test measures eight areas of competency: telephoning, shopping, food preparation, housekeeping, laundering, use of transportation, use of medicine, and financial behavior. Participants were asked to rate how much limitation they perceived experiencing in each domain; higher scores indicated greater limitations. These areas were designed to encompass tasks that require both physical and cognitive abilities (Lawton & Brody, 1969).

Functional Activities Questionnaire (FAQ): The FAQ assessed participants' perceived difficulty with performing "advanced IADLs"; the FAQ items have greater cognitive loading, and the FAQ is frequently used to assess functional limitations prodromal to dementia. The test

measures ten domains: Writing checks, assembling tax records, shopping, working on a hobby, using appliances, food preparation, keeping track of current events, reading comprehension and attention, remembering appointments, and use of transportation. Like the Lawton and Brody IADL, the FAQ was given as a self-administered task ; higher scores indicate greater perceived limitation (highest scores go to 'total dependency; Pfeffer et al., 1982).

A functional (unit-weighted) composite score was created by averaging participants' standardized scores on the IADL and FAQ. This composite IADL/FAQ score has been used as a validity criterion in previous studies of everyday problem solving (Allaire & Marsiske, 2002). As in the constituent measures, higher scores on the Functional Composite indicated poorer functioning.

Neuropsychological Measures of Cognitive Functioning

Executive Functioning:

Of key interest to the parent study, Executive Functioning was measured in six subdomains, several with multiple measures. These capture diverse aspects of executive functioning that have been discussed in the research literature.

Working Memory: *Reading Span* is a working memory test examining the ability of a participant to keep information in working memory as they complete another task simultaneously. The participant was asked to read a series of sentences out loud, answer questions about them, and then recall the last word of each sentence (Salthouse & Babcock, 1991). The *Letter-Number Sequencing* measure from the Wechsler Adult Intelligence Scale-Third Edition (WAIS-III) was also included and involves the administrator reading a series of letters and numbers aloud and the participant must say the numbers first, in order, then the letters in alphabetical order (Wechsler, 1997).

Switching: Task **switching**, or set shifting, is an **executive** function and a kind of cognitive flexibility that involves the ability to shift attention between one task and another. The participant was given the *Trail Making Test B*, which required the participant to switch between connecting numbers and letters on a page as fast as possible without making mistakes (Reitan, 1992).

Fluency: The Controlled Oral Word Association (COWA) is comprised of two parts, letter fluency (COWA FAS) and animal fluency (COWA). ,COWA FAS, measures the participant's word fluency, in which the participant was asked to say as many words as possible that begin with a certain letter of the alphabet or in a certain semantic category in 60 seconds (Benton, Hamsher, & Sivan, 1994). COWA animal fluency measures participant's category fluency, in which the participant was asked to say as many animals in 60 seconds (Benton, Hamsher, & Sivan, 1994). Higher scores indicate greater fluency. Composite verbal fluency was calculated by averaging the standardized value z-scores of COWA FAS letter fluency and COWA animal fluency. These averages represent verbal fluency in the analyses.

Planning: Planning is the process of organizing the activities required to achieve a desired goal. The DKEFS Tower Test, which stands for Delis-Kaplan Executive Function System, measures nonverbal executive functions such as spatial planning, rule learning, inhibition of impulse, and the ability to maintain an instructional set. In this test, participants are shown a picture of a tower made of blocks, and the participant is asked to recreate the tower using the fewest number of moves possible while following specific rules, such as that he or she may only use one hand, and must not place a larger block on top of a larger one (Delis, Kaplan, & Kramer, 2001).

Inhibition: Inhibition refers to the ability to filter out stimuli that are task irrelevant. The DKEFS Color Word Interference task examined the ability to inhibit oneself from an action that seems natural. For example, as part of the task, the participant is asked to look at words of colors that are printed in different colored ink, and the participant must determine when he or she should read the printed word, or name the color of the ink (Delis, Kaplan, & Kramer, 2001).

Reasoning: Reasoning refers to the ability to form understanding and apply logic. The Word Series test measures the ability of the participant to complete inductive reasoning tasks through determining the next word in a pattern of words (Gonda & Schaie, 1985).

Non-Executive Functioning Measures:

These tasks were run to show convergent and divergent validity between measures of executive functioning and divergent production.

Logical Memory 2**:** The Wechsler Memory Scale –3rd edition Logical Memory 2 subtest delayed condition assesses long-term narrative memory with free recall and recognition tasks after a 30-minute delay. The examinee is asked to retell two stories from an immediate condition which are copied verbatim by the examiner, assessing recall. Then the examinee is asked yes/no questions about both stories, assessing recognition. Trained examiners administer this test. (Wechsler, 1997b) Higher scores indicate greater logical memory.

WRAT-4: The Wide Range Achievement Test (WRAT-4) is a reading, pronunciation, and literacy task that measures premorbid intellectual functioning. Participants must perform reading comprehension, recognize and name letters, pronounce printed words, write their name as well as letters and words from diction, count, read number symbols, and preform oral and written computations (Wilkinson and Robertson, 2006). This task was administered to assess crystalized

abilities and ultimately establish validity between executive fluid abilities and divergent thinking tasks.

Table 2. Measures

Ability	Measure	Description	Reference
Executive Functioning			
Working Memory	Reading Span	Requires participant to answer questions about sentences while also remembering the last word in each sentence	Salthouse & Babcock, 1991
	WMS-III Letter-Number Sequencing	Working memory span task that requires manipulation of numbers and letters	Wechsler, 1997b
Switching	Trail Making Test	Part B: Switching between connecting number and letters	Reitan, 1992
Fluency	Controlled Oral Word Association Test (COWA)	Speeded retrieval task of words that start with a specific letter and that fit within a semantic category	Benton, Hamsher, & Sivan, 1994
Planning	DKEFS Tower Test	Measure that requires planning and self-monitoring in order to create the pattern of the tower	Delis, Kaplan, & Kramer, 2001
Inhibition	DKEFS Color-Word Interference Test	Participant must say color of ink and inhibit the pre-potent response to read the word	Delis, Kaplan, & Kramer, 2001
Reasoning	Word Series	Measure of inductive reasoning ability	Gonda & Schaie, 1985
Take Home Measures			
Questionnaires	Instrumental Activities of Daily Living	Self-report measure of physical and cognitive instrumental activities of daily living	Lawton & Brody, 1969
	Functional Activities Questionnaire	Self-report measure of functioning on IADLs	Pfeffer et al., 1982
Non-executive functioning measures			
Memory	WMS-III Logical Memory 2	Measure of prose learning and Recall	Wechsler, 1997b
Literacy	Wide Range Achievement Test (WRAT) 4	Reading pronunciation/literacy task	Wilkinson and Robertson, 2006

Procedures

Participants were required to attend two visits during the course of the study—both took place at the Village Retirement Community, as well as completed additional take-home self-report measures. The first day included: consenting, questionnaires, completion of the complex everyday cognitive tasks, and some cognitive measures, which took approximately 2-2.5 hours. The second day included the neuropsychological testing, which also took approximately 2-2.5 hours. All test administration was standardized with verbal instructions to participants, and administered by trained research assistants. Participants also completed approximately 1 hour of questionnaires that were filled out at home and returned at the second testing session.

Trained research assistants followed an established procedure. Before being eligible to become a tester, the assistants observed multiple full-length sessions, attended individual training sessions, practiced test administration, and were observed while testing until he or she was deemed qualified for independent testing. Additionally, testers were trained to score and store participant data and maintain confidentiality (Thomas, 2015).

Original CEDAR Study:

The purpose of the original study, entitled Characterization of Elderly on Daily Activities in the Real-World (CEDAR), was to examine the types of errors that older adults make on complex tasks of daily functioning and determine what neuropsychological assessments predict performance on these everyday cognitive tasks. The parent study focused mostly on convergent production everyday tasks, which were not considered in the current study.

Goldman Thesis Study:

For the current thesis study, we transcribed and coded audio transcripts of divergent production tasks, and then used the divergent production scores we generated to examine associations with demographics, neurocognitive functioning, and everyday function.

Audio recordings of the Open-Ended Problem Solving Tasks for all 99 participants were transcribed word-for-word by Ms. Goldman. Each participant's oral solution responses to each question were segmented into distinct solution numbers for the purpose of separating out extraneous and/or repetitive information, and to facilitate scoring organization. Criteria for segmenting solutions are detailed in Appendix A: OEDT Segmentation Manual. As described above, each of the two OEDT questions had a "Part A" and "Part B" which were combined for transcription solution purposes because of a noticeable trend to a.) Continue to answer Part A and ignore Part B, b.) To repeat solutions in Part B that already had been generated in Part A, and c.) To seemingly not understand what Part B was asking.

Fluency

Fluency was scored as the number of safe and effective solutions that were generated for each question 1 and 2. Segmentation resulted in a breakdown of numbered distinct solutions. Next, solutions were scored as either "safe and effective" or "not safe and effective". Finally, the numbers of solutions rated "safe and effective" were totaled for a fluency score for each question. Total fluency for each participant was calculated by summing question 1 fluency and question 2 fluency.

Flexibility

Flexibility was scored based on the number of different problem solving coping styles used ranging from 0-4 for solutions considered safe and effective. Responses/solutions were

characterized into one of four coping styles by rater(s), chosen based on previous studies of practical problem solving (Cornelius & Caspi, 1987 and Denney & Palmer, 1981) and coping with real-life stressors (Billings & Moos, 1981; Lazarus & Folkman, 1984). These response styles were:

1.) Problem-focused action, which involves self-initiated, overt behaviors that deal directly with a problem and its effects (e.g., taking action to alter a situation, seeking information or advice about it) (Cornelius & Caspi, 1987).

2.) Cognitive problem analysis, which refers to intrapsychic or cognitive efforts to manage one's subjective appraisal of a situation, to understand it better, to solve the problem through logical analysis, or to reinterpret the situation from a different perspective (Cornelius & Caspi, 1987).

3.) Passive-dependent behavior that attempts to avoid or withdraw from a situation, which includes attempts to avoid or withdraw from a situation, the absence of self-initiated behaviors to alter a situation (e.g. doing nothing in a situation), or actions involving dependence on another person to solve the problem (Cornelius & Caspi, 1987).

4.) Avoidant thinking and denial that includes attempts to control the meaning of a situation through cognitive avoidance, that includes attempts to control the meaning of a situation through cognitive avoidance, denial of the situation or of one's personal responsibility in it, selective attention to things other than the situation itself, and attempts to manage one's affective reaction to a situation through the suppression of one's emotions (Cornelius & Caspi, 1987).

In the case of a rater(s) being unsure of a choice between two coping styles, they selected the style that they thought best represented the solution and wrote their reasoning in the

"comments" column of their score spreadsheet. The purpose of this was to identify uncertainties within the sample to be revisited by Ms. Goldman and resolved based on the inter-rater resolution. The number of different coping styles used was totaled for each question. The number of different styles used for questions 1 and 2 separately were averaged to determine an overall flexibility score for each participant.

Originality

A solution core bank was formed as a means to summarize the content of each solution. This permitted us to keep track of how often each solution core was mentioned, with less frequently mentioned solutions thought to be indicative of greater originality. Ms. Goldman chose solution cores that most succinctly summarized a solution yet that were still general enough to apply to other solutions. Each solution core and an example of it can be seen in the Segmenting Manual (Appendix 1). When a novel solution had a participant that did not fit under any existing cores, a new core was made to accommodate it.

Finally, synonyms and antonyms of a solution core were categorized under the core they related to most. For example, the solution cores "What does the price tag say?" "How much does it cost?" and "Is it expensive?" were all categorized under the solution core cost. While "How conservative is the treatment going to be?" Was grouped under the core "aggressive" because they are antonyms of each other.

To score originality, solution cores were assigned a distinct number and calculated by first tallying how many solutions were coded in the total sample for each solution core. In other words, every solution core had a frequency number assigned to it reflecting how common of a response it was. Next, the most common solution frequency was determined for each question.

For instance, in question 1, the solution core "size" was the most frequent with 85 mentions in the total sample. Next, proportions were determined for each solution core by dividing their frequency by the highest frequency solution in that question and inverse weighted.
For example, the highest frequency solution core was mentioned 85 times. Its proportion was calculated, 85/85 = 1 and inverse weighted 1/1 = 1. A solution core with a frequency of 4 yielded a proportion of 4/85 = 0.047, which in turn was inverse weighted 1/0.047 to yield a final originality score of 21.277. Therefore, higher scores reflected greater originality.

Because originality scores derived via inverse weighting could tend to be positively skewed, the median originality score was computed across all solutions generated for a question by each participant. These median scores were then averaged across question 1 and question 2 to produce an overall originality score for each participant. Median averages were computed to help normalize the data.

Raters, Inter-rater Reliability, and Resolving Inter-rater Dispute

Coding of the Open-ended Decisions Tasks (OEDT) was done primarily by the Principal Investigator (Annika Goldman) who also entered all of the OEDT data. Two additional coders (Jacqueline Maye, M.S.) and (Michael Marsiske, Ph.D), coded 3 participants' tasks and discussed discrepancies with the principal investigator's codes of the same participants before being deemed trained to code more participants. In total, 23% of the data was coded by the Principal Investigator and a second rater, and the Principal Investigator scored the remaining 77% of the data. The second rater scored fluency and flexibility, while the Principal Investigator scored fluency, flexibility, and originality. Therefore inter-rater reliability is based on fluency and flexibility. When there were disputes in the sample of 3 three participants that were triple

scored, the majority (2 out of 3) determined the final coding. For the remaining tasks that were only scored by two coders, disputes were resolved by a third coder. After reliability checks and consensus re-scoring of 23% of participants, 3% of solutions in the remaining 77% of participants were revisited. The solutions that were revisited were ones in which the single coder made notes in the comments column expressing uncertainty in scoring, and represent 3% of the total solutions. Notes were made in the comments column when the rater was unsure about their coding. Updates were made on these revisited solutions to be consistent with the rules and principles formulated on the 23% that were double or triple scored. Of these revisited solutions, 18% of fluency scores were changed, and 9% of flexibility scores were changed.

Table 3

Descriptive Statistics for OEDT Fluency, Flexibility and Originality

	Fluency			Flexibility			Originality		
	mean	SD	range	mean	SD	range	mean	SD	range
Combined	21.68	8.89	4-48	1.70	0.64	1-3.50	4.02	1.12	2.22-7.71
Question 1	11.85	6.14	3-41	1.66	0.75	1-3	4.01	1.58	1.98-10.63
Question 2	9.84	4.36	1-21	1.75	0.82	1-4	4.03	1.51	1.77-10.63

Note: Combined = Question 1 + Question 2. For fluency, participants were encouraged to generate as many responses as they wished, with no time limits. Flexibility could range from 0-4 (where 4 was the maximum number of coded coping styles they could endorse). For originality, each solution was coded as how often it was mentioned by participants (high numbers were frequently mentioned, low numbers infrequently). These frequency scores were then made into a proportion by the maximum frequency any solution could be mentioned (85 for Question 1, 65 for Question 2). These proportions were then reciprocally transformed, so that higher scores represented greater originality (less frequent mention).

For the 23% of double-rated transcripts, inter-rater reliability was assessed via intraclass correlation (one-way random effects model; McGraw & Wong, 1996). The one-way random

model is the only allowable approach when not every rater rates every transcript. The "single measure" reliability was computed (i.e., the reliability of a single rater when compared to another rater), since the majority of solutions in this study were rated by a single rater.

Cohen's kappa could not be used in this study because (a) multiple solutions generated by each participant would violate the assumption of independent observations, and (b) there was a high chance agreement (most solutions were rated as effective, and most solutions were rated as "cognitive analysis"). The intra-class coefficient thus provides a better estimate of judges' consistency of interindividual ranking of participants across many generated solutions. High reliability was found between the two raters' fluency scores (Q1 Single Measures: 0.978, $p< 0.01$; Q2 Single Measures: 0.986, $p< 0.01$). Single measure predicts how reliable a single rater would be based on the double rated scores.

High reliability was also found between the two rater's flexibility sub-score *Cognitive Analysis* in Question 1 and Question 2 (Q1 Single Measures: 0.959, $p< .001$; Q2 Single Measures: 0.969, $p< .001$). Significant but moderately low reliability was found between two rater's flexibility sub-score *Problem Focused* in Question 1 and 2 (Q1 Single Measures: 0.783, $p< .001$; Q2 Single Measures: 0.425, $p<.05$). Significance, but not high reliability was found between two rater's flexibility sub-score *Passive Dependent* in Question 1 and 2 (Q1 Single Measures: 0.538, $p< .001$; Q2 Single Measures: 0.455, $p<.05$). Significance, but not high reliability was found between two rater's flexibility sub-score *Avoidant* in question 2 (Q2 Single Measures: 0.656, $p< .001$). No rater coded *Avoidant* for Question 1 in this sample. Taken together, these ICC results suggest substantial consistency between raters on fluency and flexibility for each question, at least in those domains with sufficient frequency. Not surprisingly, coping dimensions with low variance also had attenuated reliability/inter-rater consistency. Thus

the apparent lack of reliability is a sort of methodological consequence of low occurrence of those coping styles. Single measure intra class correlation and p values can be seen in Table 4a and Table 4b.

Table 4a

Intra Class Correlation Coefficient Question 1

		95% Confidence interval		F Test with True Value 0			
	Intraclass Correlation	Lower bound	Upper Bound	Value	df1	df2	Sig
Single Measures	0.978	0.948	0.991	89.693	21	22	0
Average Measures	0.989	0.974	0.995	89.693	21	22	0

Table 4b

Intra Class Correlation Coefficient Question 2

		95% Confidence interval		F Test with True Value 0			
	Intraclass Correlation	Lower bound	Upper Bound	Value	df1	df2	Sig
Single Measures	0.986	0.966	0.994	137.308	21	22	0
Average Measures	0.993	0.983	0.997	137.308	21	22	0

Statistical Analysis

Aim 1: Determine if any apparent age, gender, or educational differences exist in older adults' divergent production.

Analysis: Three multiple regression analyses were run to test if demographic variables significantly predicted OEDT scores of divergent production. The divergent production

dependent variables were fluency, flexibility, or originality. In all three models, the independent variable predictors were age, education, and gender.

Aim 2: Examine relationships between traditional neuropsychological measures of executive functioning (EF) dimensions in older adults and their divergent production dimensions on the Open-Ended Decisions Tasks.

Analysis: Three hierarchical regressions with fluency, flexibility, and originality as dependent variables were run to examine the relationship between EF dimensions and OEDT dimensions. The blocks were ordered in a defined conceptual order starting with demographics, followed by simple to increasingly more complex cognitive processes of interest in a forced entry hierarchical regression. The goal was to examine the unique and additive contribution of specific blocks as opposed to the significance of individual predictors.

The dependent variables are fluency, flexibility, and originality. The independent variables are Block 1, Block 2, and Block 3. Block 1 consisted of age, education, and gender. Block 2 consists of non-executive cognitive measures, the WRAT-4 and Logical Memory II. Block 3 consists of executive functioning cognitive measures, the Tail Making Test B time, Letter Number Sequencing, DKEFS Tower Test total achievement, Color-word interference, Word Series, and the DKEFS COWA verbal fluency composite (letter + animal fluency).

Aim 3: Determine if a relationship exists between the dimensions of the Open-Ended Decisions Tasks (fluency, flexibility, and originality) and self-reported measures of perceived limitations with functional activities of daily living.

Analysis: One hierarchical regression was conducted, with a Functional Composite (consisting of the average of the OARS IADL and Pfeffer FAQ) serving as the dependent variable. The

blocks were ordered in a defined conceptual order from demographics and non-executive cognitive measures followed by simple to increasingly more complex cognitive processes and the dimensions of the OEDT in the final block. The goal was to examine the unique contribution of specific blocks as opposed to the significance of individual predictors (although, in the final model, the significance of each predictor was inspected; because of high within-block multicollinearity, it was expected that the unique predictive variance of single b-weights might be low).

The dependent variable is the Functional Composite. The independent variables are Block 1, Block 2, Block 3, and Block 4. Block 1 consisted of age, education, and gender. Block 2 consists of non-executive cognitive measures, the WRAT-4 and Logical Memory II. Block 3 consists of executive functioning cognitive measures, the Tail Making Test B time, Letter Number Sequencing, DKEFS Tower Test total achievement, Color-word interference, Word Series, and the DKEFS COWA verbal fluency composite (letter + animal fluency). Block 4 consists of the OEDT dimensions, fluency, flexibility, and originality.

CHAPTER 4 RESULTS

Results

Participants: The sample for this study began with 99 participants, based on the total number of complete or incomplete OEDT transcriptions. 8 of these were excluded due to inaudible recordings and/or missing questions. The final sample for this study is 91 participants. About half of the participants were recruited from a retirement community, which is likely to have an over-representation of highly educated, and high-SES individuals in part because of the private-pay costs of admission (Ball, Perkins, Hollingsworth, Whittington, & King, 2008). The average age was 80.21 (range= 65-96). The average years of education was 15.94 (range= 9-20). The sample was 72.5% female and 4.4% non-white. Demographic means can be seen below (Table 5).

Table 5

Participant Demographics

	Mean (SD)	Range
Age (years)	80.21 (8.73)	65-96
Education (years)	15.94 (2.77)	9-20
Female	72.5%	-
Non-White	4.4%	-

Aim 1: Multiple regression analyses were used to test if age, gender and education (IVs) significantly predicted OEDT scores of divergent production. Descriptive statistics for each of the three OEDT divergent production dependent variables of fluency, flexibility, and originality can be seen in Table 3.

In this model, the omnibus test is significant (p=.034) meaning that the three demographic predictors of age, gender, and education together significantly predict OEDT fluency. 9.4% of the variance in OEDT fluency is explained by these three predictors together. However, this seems to be driven primarily by age (β= -0.291), as age is the only individual variable in the model that significantly predicts OEDT fluency. Each year of age increase predicts a -0.296 unit decrease in OEDT fluency *(*β=-0.296, *p*=.006). The correlation between age and fluency is depicted in Figure 1.

Demographic variables (age, gender education) were not significantly predictive of either OEDT Flexibility with an omnibus test significance of (p=0.292) or OEDT Originality with an omnibus test significance of (p=0.317). β and p-value for the regression analysis of demographics on OEDT score dimensions may be viewed in Table 6.

Table 6

Multiple Regression of Fluency, Flexibility, and Originality on Age, Gender and Education

	Fluency			Flexibility			Originality		
	B	SE	p	B	SE	p	B	SE	p
Age	-0.296	0.106	0.006	0.009	0.008	0.251	-0.11	0.014	0.434
Gender	-0.192	0.34	0.928	0.092	0.158	0.564	-0.142	0.276	0.608
Education	0.309	2.133	0.365	0.029	0.025	0.25	-0.072	0.044	0.103
	Coefficient	p		Coefficient	p		Coefficient	p	
R^2	0.094	0.034		0.042	0.292		0.040	0.317	

Note: Fluency = Sum of safe and effective solutions Q1+Q2, Flexibility = Average number of different coping styles used Q1+ Q2, Originality = average (inverse proportion) originality score across Q1 + Q2.

Table 7

Correlations between Age, Gender, and Education, and Fluency, Flexibility, and Originality (n=91)

		Fluency	Flexibility	Originality
Age	Pearson Correlation	-0.29**	0.132	-0.098
Gender	Pearson Correlation	-0.086	0.119	-0.025
Education	Pearson Correlation	0.093	-0.14	-0.166

Note: ** Correlation is significant at the 0.01 level (2-tailed). * Correlation is significant at the 0.05 level (2-tailed)

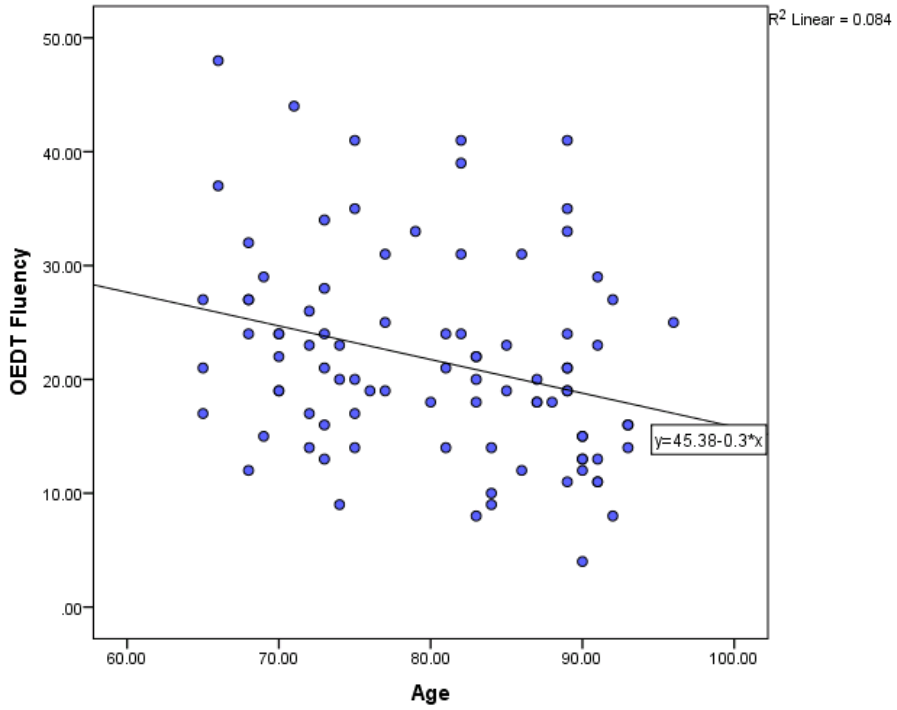

Figure 1. OEDT Fluency and Age

Note: Negative correlation between OEDT fluency score (total number of safe and effective solutions) and age of participant.

Aim 2: Hierarchical regressions were run separately for each of the three OEDT divergent production dimensions. Tables 8 to 10 show the change in variance explained by block for each of the three OEDT divergent production dimensions. Overall, none of Block 1 (demographics), 2 (non-executive measures) or 3 (executive functioning measures) explained significant variance in fluency, flexibility, or originality.

Table 11 shows the specific beta weights and p-values of the models. Although the demographic block as a whole did not explain significant variance in OEDT dimensions, consistent with our aim 1 finding, age emerged as a significant unique predictor in our final model for the prediction of OEDT fluency (β=-.256, p=.018).

Additionally, although the executive functioning measures block as a whole did not explain significant variance in OEDT dimensions, the COWA verbal fluency composite emerged as a significant unique predictor in our final model for the prediction of OEDT fluency (β=3.471, p=.009). This correlation is depicted below in Figure 2. Other significant correlations in Block 3 of the fluency model were Logical Memory 2 and Trail B time. The significance of Logical memory 2 is important to note because it is a non-executive measure. These correlations can be viewed in Table 12.

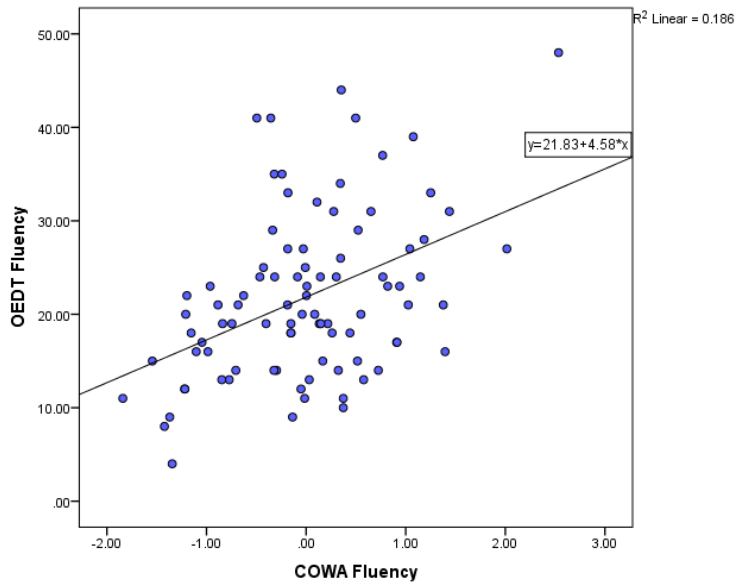

Figure 2. OEDT Fluency and COWA fluency

Note: Positive correlation between OEDT frequency scores (number of safe and effective solutions) a composite neuropsychological measures COWA of verbal fluency (FAS + Animals).

Table 8

Hierarchical Regression of OEDT Fluency

	Block 1			Block 2			Block 3		
	B	SE	p	B	SE	p	B	SE	p
Age	-0.256	0.106	0.018	-0.187	0.113	0.102	-0.177	0.125	0.158
Gender	-0.128	2.102	0.952	-0.608	2.107	0.774	-0.149	2.208	0.946
Education	0.097	0.347	0.78	-0.152	0.41	0.711	0.028	0.417	0.946
Logical Memory 2				0.114	0.118	0.338	0.082	0.133	0.542
WRAT-4				0.234	0.204	0.255	0.136	0.217	0.533
Trails B							-0.483	0.518	0.355
L/N Sequencing							-0.008	0.018	0.664
DKEFS Tower test total achievement							0.032	0.26	0.902
Color-word interference							-0.014	0.042	0.748
Word series							-0.121	0.226	0.592
COWA composite verbal fluency							3.471	1.293	0.009
	Coeff	p		Coeff	p		Coeff	p	
R^2	0.068	0.116		0.104	0.103		0.200	0.083	
ΔR^2	0.068	0.116		0.036	0.195		0.096	0.183	

Note: Non-executive measures are Logical Memory 2 the WRAT-4. Executive functioning cognitive measures are Trail making b time, Letter number sequencing, DKEFS tower test total achievement, Color-word interference, Word series, DKEFS COWA verbal fluency composite (letter + animal fluency). Blocks 1 - 3 represent the sequence that the regression was run in.

Table 9

Hierarchical Regression of OEDT Flexibility

	Block 1			Block 2			Block 3		
	B	SE	p	B	SE	p	B	SE	p
Age	0.011	0.008	0.17	0.018	0.008	0.037	0.015	0.01	0.12
Gender	0.096	0.158	0.546	0.053	0.156	0.737	0.07	0.169	0.68
Education	-0.041	0.026	0.118	-0.062	0.03	0.045	-0.057	0.032	0.078
Logical Memory 2				0.012	0.009	0.159	0.012	0.01	0.25
WRAT-4				0.019	0.015	0.202	0.017	0.017	0.303
Trails B							-0.038	0.04	0.34
L/N Sequencing							-6.56E-05	0.001	0.962
DKEFS Tower test total achievement							0.011	0.02	0.57
Color-word interference							0	0.003	0.923
Word series							-0.009	0.017	0.604
COWA composite verbal fluency							0.148	0.099	0.139
	Coeff	p		Coeff	p		Coeff	p	
R^2	0.062	0.143		0.121	0.056		0.161	0.227	
ΔR^2	0.062	0.143		0.059	0.071		0.040	0.725	

Note: Non-executive measures are Logical Memory 2 the WRAT-4. Executive functioning cognitive measures are Trail making b time, Letter number sequencing, DKEFS tower test total achievement, Color-word interference, Word series, DKEFS COWA verbal fluency composite (letter + animal fluency). Blocks 1-3 represent the sequence that the regression was run in.

Table 10

Hierarchical Regression of OEDT Originality

	Block 1			Block 2			Block 3		
	B	SE	p	B	SE	p	B	SE	p
Age	-0.014	0.014	0.316	-0.023	0.015	0.129	-0.033	0.017	0.051
Gender	-0.143	0.274	0.603	-0.114	0.276	0.679	-0.069	0.298	0.817
Education	-0.061	0.045	0.178	-0.059	0.054	0.278	-0.06	0.056	0.288
Logical Memory 2				-0.023	0.015	0.139	-0.019	0.018	0.285
WRAT-4				-0.003	0.027	0.897	0.005	0.029	0.868
Trails B							-0.077	0.07	0.277
L/N Sequencing							-3.00E-03	0.002	0.289
DKEFS Tower test total achievement							0.021	0.035	0.546
Color-word interference							0	0.006	0.933
Word series							-0.015	0.03	0.615
COWA composite verbal fluency							-0.161	0.175	0.358
	Coeff	p		Coeff	p		Coeff	p	
R^2	0.038	0.349		0.068	0.314		0.115	0.543	
ΔR^2	0.038	0.349		0.030	0.270		0.047	0.672	

Note: Non-executive measures are Logical Memory 2 the WRAT-4. Executive functioning cognitive measures are Trail making b time, Letter number sequencing, DKEFS tower test total achievement, Color-word interference, Word series, DKEFS COWA verbal fluency composite (letter + animal fluency). Blocks 1-3 represent the sequence that the regression was run in.

Table 11

Variance Explained in Hierarchical Regression

	Fluency		Flexibility		Originality	
	R^2 (Adj.R^2)	Sig (p)	R^2 (Adj.R^2)	Sig (p)	R^2 (Adj.R^2)	Sig (p)
Block 1: Demographics	.068 (.034)	0.116	.062 (.029)	0.143	.038 (.004)	0.349
Block 2: Non-Executive Measures	.104 (.049)	0.103	.121 (.067)	0.056	.068 (.012)	0.314
Block 3: Executive measures	.200 (.084)	0.083	.161 (.040)	0.227	.115 (.013)	0.543

Note: Adj. R^2 = Adjusted R^2, Sig = significance p-value. Block 1 (Demographics) = age, education, and gender. Block 2: Non-executive cognitive measures: WRAT-4 and Logical Memory II. Block 3: Executive functioning cognitive measures: Trail making test b time, Letter number sequencing, DKEFS tower total achievement, Color-word interference, Word series, DKEFS COWA verbal fluency composite (letter + animal fluency)

Table 12

Correlations between Executive Cognitive Measures and Fluency, Flexibility, and Originality

		Fluency	Flexibility	Originality
WRAT-4	Pearson Correlation	0.182	0.059	-0.108
	Sig. (2-tailed)	0.086	0.583	0.313
	N	90	90	90
Logical Memory II Total	Pearson Correlation	0.287**	0.152	-0.152
	Sig. (2-tailed)	0.006	0.153	0.154
	N	90	90	90
Letter-Number Sequencing	Pearson Correlation	0.179	-0.074	-0.141
	Sig. (2-tailed)	0.092	0.488	0.185
	N	90	90	90
Trails B Time (in seconds)	Pearson Correlation	-0.256*	-0.032	-0.003
	Sig. (2-tailed)	0.015	0.763	0.976
	N	89	89	89
COWA composite	Pearson Correlation	0.431**	0.163	-0.134
	Sig. (2-tailed)	0.000	0.125	0.209
	N	90	90	90
DKEFS Tower: Total Achievement Score	Pearson Correlation	0.137	0.09	-0.077
	Sig. (2-tailed)	0.197	0.397	0.47
	N	90	90	90
Stroop Color-Word interference	Pearson Correlation	-0.178	-0.069	0.019
	Sig. (2-tailed)	0.093	0.516	0.862
	N	90	90	90
Word Series	Pearson Correlation	0.154	-0.026	-0.078
	Sig. (2-tailed)	0.149	0.807	0.47
	N	89	89	89

Note: ** Correlation is significant at the 0.01 level (2-tailed). * Correlation is significant at the 0.05 level (2-tailed).

Aim 3: Prior to commencing analyses, positive skew was found in the functional composite measure, owing to the relatively low levels of functional limitation reported in most community dwelling elders. Since general linear modeling approaches like correlation and regression assume normally distributed dependent variables, the functional composite was Blom-transformed to achieve a more normally distributed outcome variable. The positive skew of the original sample is depicted in Figure 3 and the improvements in skew after Blom Normalized is depicted in Figure 4

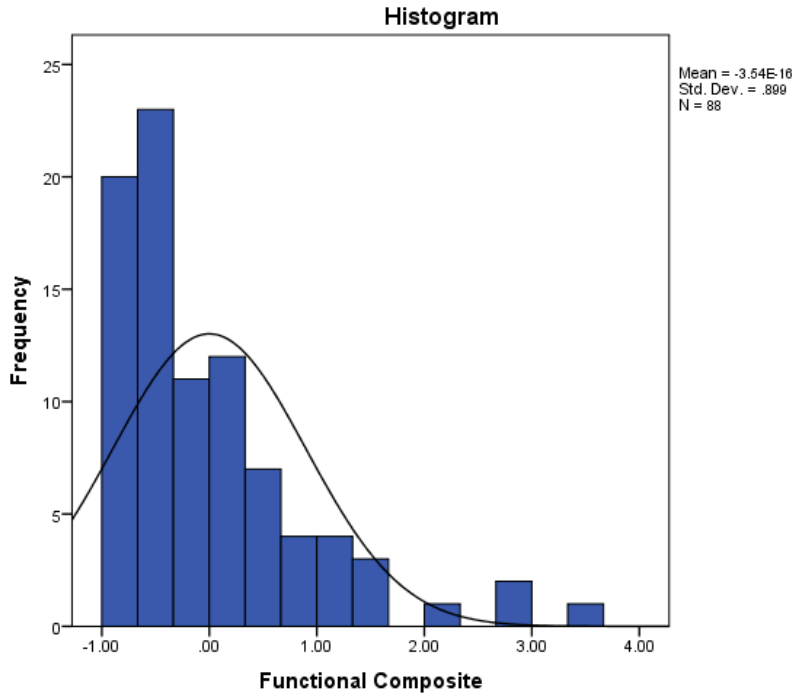

Figure 3. Positive Skew functional composite scores

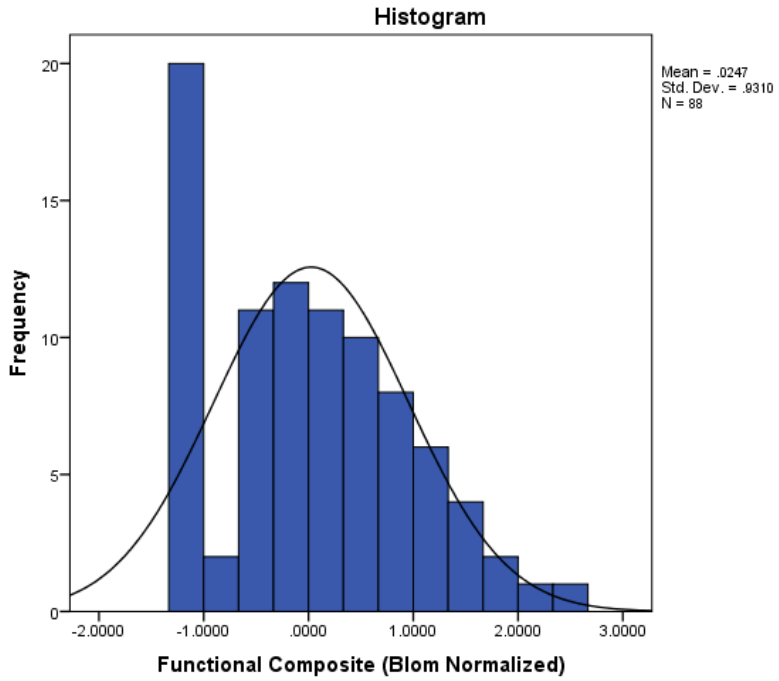

Figure 4. Blom-normalized functional composite scores

A hierarchical regression was run to determine if, above and beyond traditional cognitive measures, the OEDT divergent production scores added explanatory variance to understanding daily functioning abilities. Blocks 1 (demographics, total R^2 =.245), 2 (memory and language added, total R^2= .361), 3 (executive functioning added, total R^2 = .458) and 4 (OEDT fluency/flexibility/originality, total R^2 = .494) each yielded models that had a global r-squared value that was significantly greater than zero ($p < .001$). The Block 1 (demographics) variables explained 24.5% of the variance in the functional composite ($p < .001$). The addition of Block 2 (memory and language/non-executive cognitive function) further significantly improved the model and explained an additional 11.5% variance in the functional composite (F Change p=.001). The addition of Block 3 (executive functioning) further significantly improved the model and explained an additional 9.7% variance in the functional composite (F

Change p<.05). Block 4 (OEDT divergent production) beyond that did not explain additional significant variance (Sig F. Change >.05)

Hierarchical regressions of functionality care depicted on Table 13. Although Block 4 was not significant, the OEDT fluency measure is approaching significant prediction of function. Table 14. Shows correlations between Blom-Transformed functionality composite scores and fluency, flexibility, and originality. There were no significant correlation between dimensions of divergent production and functionality composite scores.

Table 13

Hierarchical Regression of Functionality

	Block 1			Block 2			Block 3			Block 4		
	B	SE	p	B	SE	p	B	SE	p	B	SE	p
Age	0.051	0.010	0.000	0.037	0.010	0.001	0.031	0.011	0.006	0.038	0.012	0.002
Gender	-0.173	0.197	0.383	-0.122	0.186	0.515	-0.290	0.189	0.130	-0.277	0.187	0.143
Education	0.017	0.033	0.612	0.020	0.036	0.575	-0.007	0.036	0.839	-0.007	0.037	0.858
Logical Memory 2				-0.036	0.010	0.001	-0.022	0.012	0.060	-0.021	0.012	0.079
WRAT-4				-0.006	0.018	0.747	0.014	0.019	0.451	0.013	0.018	0.494
Trails B							0.004	0.002	0.031	0.004	0.002	0.021
L/N Sequencing							0.007	0.045	0.876	0.002	0.045	0.656
DKEFS Tower test total achievement							-0.330	0.022	0.148	-0.035	0.022	0.124
Color-word interference							0.003	0.004	0.361	0.004	0.004	0.318
Word Series							-0.001	0.020	0.956	0.001	0.019	0.963
COWA comp verbal Fluency							-0.086	0.111	0.445	-0.127	0.117	0.281
Fluency										0.018	0.011	0.098
Flexibility										-0.073	0.135	0.590
Originality										0.074	0.077	0.340
	Coef.	p		Coef.	p		Coef.	p		Coef.	p	
R^2	0.245	0.000		0.361	0.000		0.458	0.000		0.494	0.000	
ΔR^2	0.245	0.000		0.115	0.001		0.097	0.048		0.036	0.169	

Note: Non-executive measures are Logical Memory 2 the WRAT-4. Executive functioning cognitive measures are Trail making b time, Letter number sequencing, DKEFS tower test total achievement, Color-word interference, Word series, DKEFS COWA verbal fluency composite (letter + animal fluency). Blocks 1-3 represent the sequence that the regression was run in.

Table 14

Correlations Between Blom-Normalized Functional Composite Scores and Fluency, Flexibility, and Originality

		Fluency	Flexibility	Originality
Normal Score of Function04072017 using Blom's Formula	Pearson Correlation	-0.098	-0.031	0.095
	Sig. (2-tailed)	0.366	0.777	0.378
	N	88	88	88

Note: **. Correlation is significant at the 0.01 level (2-tailed).

CHAPTER 5 DISCUSSION

Discussion

Key findings of the current investigation are briefly summarized first. The remainder of this chapter then considers the broader conceptual implications of the study findings, key limitations, and future directions/conclusions.

Summary of Key Findings

Age significantly predicted OEDT fluency. Age, education and gender were not predictive of flexibility or originality. In contrast age was significantly and negative associated with fluency. The latter finding isconsistent with a cross-sectional, longitudinal, and cross-sequential analysis of a variety of divergent thinking tasks, which demonstrated a significantly negative correlation between age and six divergent thinking tasks (McCrae, Arenberg, & Costa's 1987). Age may have been related to fluency performance but not flexibility because fluency naturally had more variance than flexibility (as discussed below).

Neuropsychological measures of fluency were related to OEDT fluency. Executive functioning overall was not a significant unique predictor of OEDT scores (after controlling for demographic and non-executive variables), however upon closer examination, there were a few significant relationship between executive functioning measures and OEDT fluency scores with a particularly strong correlation between the COWA composite verbal fluency score and OEDT fluency scores. It makes sense that executive measures of fluency are associated with OEDT fluency because both tasks instruct participants to generate a number of responses to a specific prompt or question (i.e., shared method variance; Campbell & Fiske, 1959). Additionally, age

was a strong predictor of both the neuropsychological measures of fluency as well as OEDT fluency.

There was no significant relationship between OEDT dimensions and daily functioning. In both bivariate correlations and in hierarchical regression models accounting for demographics, non-executive measures, and neuropsychological executive functioning measures, there was no significant relationship between OEDT dimensions and daily functioning abilities.

Age was a strong predictor of daily functioning. The negative relationship between age and daily functioning is consistent with numerous studies that have shown age to be a significant and negative predictor of daily functioning (Marsiske & Margrett, 2006; Millan-Calenti, 2010). Negative age effects on function are not surprising, given the common experience of physical and cognitive decline in normal aging (Drag & Bieliauskas, 2009; West, 1996).

Neuropsychological executive functioning measures were a strong predictor of daily functioning. When controlling for demographics and the effects of non-executive cognitive measures, executive functioning was still significantly related to daily functioning. These findings support the body of research that has found executive functioning to be a domain that is consistently predictive of both self-or informant-reported Activities of Daily living (ADLs) and Instrumental Activates of Daily Living (IADLs) functioning (Cahn-Weiner, Boyle, & Malloy, 2002; Cahn-Weiner et al., 2007; Marcotte, Scott, Kamat, & Heaton, 2010; Royall et al., 2007). This is important because it demonstrates the importance of executive functioning abilities specifically in daily functioning.

Theoretical and Conceptual Considerations

The literature review introduced a number of conceptual and empirical considerations, which guided the specific aims of this study. This section considers how findings from this study might help to advance our understanding of divergent production as it relates to everyday problem solving in older adults.

Age was a significant negative predictor of fluency on the OEDT. While it is possible to conceptualize this as a "decline" process (i.e., as fluid cognition declines, so does everyday fluency, with which it is related), it is also possible to speculate that the accumulation of age-related experience might also reduce aspects of divergent production. With age, it is possible that people have had more opportunities in their lives to recognize which solutions are effective and ineffective when it comes to solving familiar problems (Baltes, 1993). Therefore they may not provide as many solutions because they have already filtered the non-useful ones through their life's experiences (Tordessiallas & Chaiken, 1999). Anecdotally, we saw this in comments like "I always choose a particular brand" or "I'd want to limit it to Smart TVs".

Divergent production is often categorized as a component of fluid intelligence, which is more sensitive to cognitive aging, compared to crystalized intelligence such as education and life experiences (Cattell & Horn, 1971). The OEDT asks questions involving everyday problems that participants are more likely to be familiar with compared to a divergent production task that assess novel problem solving. Again, experience has been found to be protective to cognitive decline. Therefore, due to higher likelihood of familiarity with the task questions, it is unknown to what extent participants's reliance on crystalized abilities, or familiarity with the task, contributed to the lack of predictability of executive functioning measures on the OEDT.

Some investigators have noted a change in the style or approach that older respondents take to problem solving and decision making tasks. In summary, the argument is that, relative to younger adults, older adults tend to use less information and review fewer bits of information and less exhaustive search in decision making (Finucane et al 2005; Johnson & Drungle, 2000; Meyer, Russo & Talbot, 1995; Patrick & Strough, 2004). Berg and colleagues (1999) referred to this as the "older/selective" problem solving style. The idea is that older adults use and generate less information in solving complex problems to reduce the information load that they need to hold in mind. This is thought to be a compensatory approach to deal with age-related restrictions in processing capacity (Marsiske & Margrett, 2006)

Fluency on the divergent production tasks of OEDT was significantly negatively correlated with age while flexibility and originality were not. Fluency is a particularly important driver for creative problem solving because theoretically, the generation of more potential solutions increases one's odds of coming up with an effective way to solve a problem. Fluency is relevant because if age affects the ability to produce many different solutions to a problem, older adults may be at a disadvantage when solving complex problems of daily living that require them to "brainstorm" possible solutions.

An open question is whether "everyday" divergent production needs to be specifically assessed. In this study, traditional neurocognitive measures of executive function were more consistently predictive of self-rated functioning than the OEDT scores. There was also no incremental benefit of the OEDT for predicting functionality (in constrast to a similar study reported by Allaire & Marsiske, 2002). The theory driving the study of divergent production on everyday problem solving tasks is that complex problems often do not have a single correct solution. When solutions that were once useful, prove unviable at one's present age and ability

level, practical creativity may come into play to overcome these challenges (Marsiske & Willis, 1998). Understanding how aging effects problem solving is still a relevant topic, however open-ended executive functioning tasks that assess fluency may be sufficient in assessing functional competence.

With that being said, other studies using open ended tasks of everyday problem solving have been predictive of functional competency (Poon et al, 1992). In a study by Allaire, a common open-ended problems test the OEEPT was used (Denney, 1989). The OEEPT consists of 6 questions and was similarly not related to basic cognitive abilities except for a fluency task (Allaire & Marsiske, 2002). Functional competence in the Allaire study was found to relate to daily functioning measures when ill-defined and well-defined measures of everyday problem solving were combined. Perhaps a greater number of questions or a variety of well and ill-defined questions would result in a test with more predictive validity of everyday problem solving.

Study Limitations

There was a lack of demographic, and functional, and cognitive ability diversity in the sample. There was a high mean age relative to most aging studies (mean age=80.49). The sample was also highly educated (mean education = 16.04) and not racially/ethnically diverse. Education is particularly important to consider because education has a substantial effect on cognitive functioning (Van Hooren et all., 2007). A common pitfall of aging research is that healthy and educated older adults are more likely to volunteer for research studies, therefore resulting in a less diverse and generalizable sample. Indeed, in order to even meet our basic study requirements, participants needed to be able to use the telephone and access regular

transportation, both of which were components of the IADL. Particularly in functional diversity, the sample was quite skewed toward high functioning and had to be normalized in order to appropriately conduct analyses to detect differences between participants. In a future study it would be helpful to include additional non self-reported measures such as clinician-assessments of IADL functioning to prevent ceiling effects.

In addition to the cognitive contributions to everyday functioning, experience may have had an effect on OETD responses. A body of literature suggests that experience may also be an important aspect of older adult's everyday functioning (Cornelius & Caspi, 1987; Willis, 1996b; Willis & Schaie, 1986). Task familiarity may also have the potential to increase components of fluency. For instance, if someone watches a great deal of TV, or has bought a TV before, they may be more likely to know about all the possible factors or features that go into deciding which television to buy. Familiarity was measured and should be analyzed in a future study.

Variability was restricted in flexibility. While the OEDT successfully generated a large range of fluency scores (4-48 relevant and effective solutions) and a large number of distinct original solutions for each question across the data set (Q1: 92 distinct solutions, Q2: 70 distinct solutions), the flexibility scores were limited to four coping styles and lacked variance. There was, therefore, less score variability to explain with our predictors. Additionally, the coping style "Avoidant thinking" was more likely to be coded as not safe and effective, thus further reducing flexibility variance.

The OEDT was not originally designed to measure divergent production. Therefore the instructions as well as the way the tasks are administered are different than traditional measures of divergent production. Unlike standard tests of divergent production that prompt

participants to come up with as many unusual solutions as they can, the OEDT just asks what specific factors one should consider when making a decision. For instance, the lack of instruction to generate novel solutions may limit the potential for the OEDT to be compared to other measures of divergent production. If the OEDT were to be run again, the two parts of the question should be eliminated to reduce confusion for participants and possible effects of convergent thinking.

The OEDT follow up question may have actually discouraged divergent production. Part B of questions 1 and 2 of the OEDT, may have been inadvertently prompting convergent thinking, though responses to Part B were very similar to Part A. Part A asks for solution generation to a problem: What factors or features would you consider when buying a new television? Part B then asks: What steps would you take in narrowing down your options and making your final choice? According to the definition of *divergent thinking* which refers to the cognitive processes that help one produce multiple responses to open-ended questions or problems, and *convergent thinking* which refers to the cognitive process that helps one produce one or very few possible solutions to a given problem, Part A may be assessing divergent production while Part B inadvertently assesses convergent production.

The Functional Composite measure was positively skewed. The functional composite measure was highly positively skewed causing significant ceiling effects in our advantaged sample. Ceiling effects similarly impact any community dwelling sample as opposed to an assisted living or medical care community. Range restrictions and skew likely impacted this study's results. Finally, there is a possibility of inaccuracy in self-reported measures because participants may not be assessing themselves without bias.

Study Implications

This study accomplished the goal of creating one systemized way of scoring an open-ended problem-solving task for the components of divergent production fluency, flexibility, and originality. Although the dimensions of divergent production are largely agreed upon, the means of scoring them are not. Lack of consistency in measurement and scoring has limited our understanding of how everyday problem solving and divergent production manifest in late life. This study's scoring structure may serve as a reference for future studies attempting to code open-ended questions for the dimensions of divergent production and more broadly for creativity. Finally, Scoring according to these three dimensions of divergent thinking will allow for the OEDT to be compared to other tasks of divergent production and add to the divergent production literature.

To summarize, evidence for relationships between divergent production and specific executive functioning tasks is not particularly strong, but at least at a correlational level seems to suggest that individual differences in executive functioning and differences in divergent production fluency are associated. At least some of this is likely due to shared method variance between the fluency dimension of divergent production and the verbal fluency tasks of executive functioning. Beyond their association with one another, psychometric and "everyday" assessments of fluency are also negatively related with age. Unfortunately, as Aim 3 results show, OEDT divergent production is not strongly related to self-reported daily functioning.

The current study is consistent in showing at least some aspect of everyday cognitive divergent production is related to psychometric neurocognitive measures and age, but does not support a previous finding that such measures confer "value added" in predicting self-reported everyday functioning. This study adds to the literature related to how everyday open-ended

problem solving and divergent production apply to late life. This study included a wide range of different types of executive measures (e.g. reasoning, planning, switching, inhibition, and fluency), which gave the study potential to contribute data to conflicting literature seeking to determine which areas of executive functioning divergent thinking is most related.

Finally, this study provided analysis of under researched problem-solving scenarios that, like many problems faced by older adults, do not have a single correct solution. Discovering age as a strong predictor of divergent production confirms that age plays a role in older adult's ability to solve complex everyday problems. Further investigation is needed to determine if the OEDT is an ecologically valid measure of divergent production and to determine if divergent production can be a predictor of functional abilities in older adults.

Future Research

In order to answer questions about the predictive utility of the OEDT, future research should include a sample with more variation in cognitive functioning. This would help develop more normative data to assess functional abilities. Additional assessments such as clinical reports or other non-self reported measures of functional abilities would assist in lowering ceiling effects and potentially discovering a greater effect of divergent production in daily functioning.

The role of attention in divergent production is still not well understood. Early researchers argued that creative people have the stable trait of defocused attention allowing them to attend to differing concepts at the same time (Eysenck, 1995; Kasof, 1997; Mendelson, 1976). More recent research suggests that successful problem solving is likely a result of flexible attention in relation to task demands (Vartanian, 2009). Included in the CEDAR study is the Ruff 2 & 7 measure of selective attention and visual search speed, which allows for an analysis of

both controlled and automatic search processes (Ruff & Allen, 1996). When generating a number of solutions, in other words fluency, enough attention has to be maintained to keep solutions on topic, but de-focused enough to produce divergent responses. Exploratory studies suggest that attention control is linked to fluency (Taube-Schiff & Segalowitz, 2005). Attentional control may be an interesting influence on OEDT fluency scores and would be feasible to run in a future study.

It would be interesting to assess how performance on standardized tests of divergent thinking relates to performance on the OEDT. For instance, the Abbreviated Torrance Test of Creative Thinking is one of the most validated divergent production tasks. However this task is not specifically relevant to an older population or to everyday problem solving. Comparing performance on this test and the OEDT may help glean a better understanding of how effective the OEDT is in isolating divergent production.

There is a practice in open-ended problem solving task research to ask questions that are ambiguous and emotionally rich (Cornelius & Caspi, 1987; Denney & Pearce, 1989). Many of these researchers have also tended to stress the importance of sociocultural relevance in everyday problems. In other words, everyday problem solving is shaped by contextual demands, as well as by the goals and perceptions of the individual (Berg & Klaczynski, 1996). Perhaps with the inclusion of more problem solving tasks, there could be a higher likelihood that a task is relevant to the participant and that they may be more motivated to answer it in-depth.

Finally, previous work has suggested that experience as well as cognitive ability may be important for older adult's everyday functioning (Denney, 1989, p. 46). Participants were asked to rate how familiar they were with each question of the OEDT. It would be interesting to see if, and to what extent, task familiarity predicts increased performance on the OEDT. If asking these

questions again, a time limit should be included as well as instructions that prime the test taker to generate effective yet creative responses.

Conclusion

This study drew inspiration from established everyday problem solving and divergent thinking tasks to create a scoring system for an exploratory open-ended problem-solving task that measures fluency, flexibility, and originality. Divergent production was not a significant predictor of daily functioning. As predicted by the hypothesis, age was the strongest predictor of achievement, especially fluency, on the divergent production task of every day problem solving. There was no significant relationship between OEDT dimensions and daily functioning. However, the OEDT fluency measure was approaching significant prediction of function when it was controlled for demographics, non-executive, and executive cognitive measures while it was not approaching significance in a correlation that was not controlled by these factors.

Neuropsychological executive functioning measures were, a strong predictor of daily functioning. These findings suggest that significant measures are already in place for predicting functional abilities. Everyday problem solving is difficult to isolate because it requires one to draw on cognitive problem solving abilities as well as experience therefore further validation with other tests of divergent thinking is needed. This study contributes new scoring structure and validation to areas of the under researched topic of older adults performance on divergent production in open ended every day problem solving tasks.

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APPENDIX

Appendix A - OEDT Segmentation Manuel

Transcribe audio recordings of solutions verbatim, clearly indicating the beginning and end of each question: 1A, 1B, 2A and 2B.

1A: First, I want you to please tell me what type of factors or features Ms. Jones should consider when choosing a new television.

1B: Alright, so now you have laid out several things that you would consider, so if you had several television models to choose from, what would be the next steps in narrowing down the televisions, and how would you decide and make your final choice.

2A: So first tell me which questions she should ask her doctor when choosing a treatment option.

2B: Alright, now that you have laid out questions you would ask, if you had multiple treatment options, what would be the next step in narrowing down the treatment options, and how would you ultimately decide on the best choice?

Next, separate responses to each question into solution numbers.

Viable solutions should be separated with either a different color or underlined and clearly marked as the solution number within the transcription text. Solution numbers should begin with 1 and count continuously through parts A and B of each question. The solution numbers restart beginning at "solution 1" for the first solution of question 2.

Example: That's about all I can think of. Well I guess also <u>(Solution 10) the size of the television.</u>

Segmenting Repetitions

Repetitions of solutions within each question (1 and 2) are not assigned a solution number. When a solution in part A is repeated in part B, it is still considered a repetition. If a solution is repeated, strike through the repetition with a line and do not assign it a solution number.

Example: (Solution 3) How much does the TV cost? ~~What is the price of the TV?~~

Some solutions are very close in meaning but may be asking different questions. If the solutions are reasonably different, assign them different solution numbers.

Example: (solution 3) How much does the TV cost? (solution 4) Can Ms. Jones afford the TV?

Variations in who, what, where, when and why can assist in determining if a similar solution is counted separately.

Example: (solution 1) Where will the new TV be placed? (solution 2) Who will be placing the new TV?

How to tell if solutions are "reasonably different"

Solutions are reasonably different when they can fit into separate solution cores. View the solution core bank as a guide, and if the solutions you are considering have separate cores, they can be segmented into separate solutions.

Example: "(solution 1) How much does the TV cost? (solution 2) How much can Ms. Jones afford to pay?"

In this case, solution 1 would be classified under the core "Cost" and solution 2 would be classified under the core "Afford". Thus, they are segmented as separate solutions and not repetitions even though they may seem similar.

It is possible in some cases for solutions to be segmented separately but also have the same core.

Example: "(solution 1) She could buy her TV at Bestbuy, (solution 2) H.H. Greg, (solution 3) or Sears."

All three solutions have the core of "Store (specific)" but are segmented as separate solutions because they were generated as separate specific solutions.

If solutions are synonyms or antonyms, they are included in the same solution.

Example: "(solution 1) Is the cancer benign or malignant?" or "(solution 2) is the cancer benign or harmless?"

Solutions that do not directly answer the question

Solutions that do not directly answer the question are still counted and will be judged as safe and effective or not safe and effective during the scoring process.

Example: (Solution 2) She needs to go to the skin doctor, the dermatologist, to have this done.

Although this response is not in the form of a question, it should still be counted as a solution.

Segmenting One-word solutions

Example: "(solution 1) Surgery? (solution 2) Radiation?"

Single words may be counted as solutions if they can fall into a solution core.

Segmenting responses in a list

Each separate response in a list is counted as a solution if they are reasonably different from one another. For example:

E**xample:** "Size, cost, and color quality" would be scored as "(solution 1) Size, (solution 2) cost, and (solution 3) color quality"

Segmenting elaborations

If solutions are posed and then elaborated on, score the elaboration as part of the original solution, not as a separate solution. If the elaboration is in a different sentence and does not provide a safe and effective solution reasonably different from the previous solution posed, do not assign a solution number to it.

Example: "(solution 1) Do you want a flat screen, that's all they seem to have these days."

Example: "(solution 2) The price of the new television. They can go anywhere from 250 dollars to anything up."

Example: "(solution 5) Predicted life and (solution 6) manufacturer, name brand, and (solution 7) if the store will take care of any problems that arise with it."

In solution 10 above, "name brand" is considered an elaboration and a synonym of "manufacturer" because they are so close in meaning and "name brand" does not provide an additional safe and effective solution to the problem. Thus, it is not assigned it's own solution number.

Example: "(solution 1) The size. I mean the size of the TV screen."

Clarifications to a solution are not counted as separate solutions.

Segmenting extraneous information

Extraneous information or extensive and useless elaboration that does not provide a solution should not be assigned a solution number and their text should be left as is. Extraneous information may come in the form of a story or personal anecdote that does not provide a safe and effective solution to the question posed.

Example: "My wife works for a company that records various regimens for cancer"

Segmentation within sentences

"And", "or", and commas are useful for segmenting solutions.

Example: "(solution 1) The size and (solution 2) where she is sitting. (solution 3) Whether she wants high definition and (solution 4) a remote control."

Example: "(solution 5) Predicted life and (solution 6) manufacturer, name brand, and (solution 7) if the store will take care of any problems that arise with it."

Multiple solutions may arise in the same sentence, if solutions are reasonably different before and after an "and", "or", or comma, assign each a solution number.

Segmenting generalities and specifics

If a generality is stated along with specific and related information, that specific information is scored in the same solution number as the generality.

Example: "(solution 1) She should ask her doctor what her diagnosis is. Does she have Melanoma?"

If a generality is stated along with two or more specific additional pieces of information, the generality may be segmented with the first solution and the subsequent specific solutions scored separately.

Example: "(solution 1) How is her hearing? She may need an additional hookup to the standard sound that comes out of the set, (solution 2) headphones, or (solution 3) closed captioning.

Example: "(solution 1) Then does she want, digital or (solution 2) plasma."

Appendix B – Question 1 Solution Core Bank

Core	Solution
Adjustable	Can the TV angle be adjusted?
Afford	Can she afford it? What is Ms. Jones's Financial situation? How much does she want to spend?
Age	How old is Ms. Jones?
Alone	Does she watch TV alone? Does she watch TV with other people?
Availability	Availability of TV Is it available at the store?
Appearance	Whether Ms. Jones likes the look of it Is it pleasing to look at?
Amazon	Is she going to get it on Amazon?
Bargaining	Can you bargain a good price?
Bedroom	Will the TV be in the Bedroom?
Brand	What brand is it? What manufacturer is it?
Brand (specific)	Does she want a Samsung? I would go for a Sony The Walmart knock off brand is a good one
Brightness	Picture brightness
Blue ray	Can it play Blue Ray?
Cable	Will she need to subscribe to COX? Does she want basic cable? Who is her cable provider? Service program provided? Does she need a service contract?

Channels	How many channels does Ms. Jones will/would like to use/s Which channels does Ms. Jones watch?
Cost	What is the cost / price? What is the best deal?
Clarity	Picture clarity
Closed Captioning	Does it have Closed Captioning How big are the words at the bottom?
Computer	Ability to connect computer to TV
Consumer reports	What do the ratings say? I would look at consumer reports
Color / B&W	Does she want a color television or black and white television?
Color (picture)	Color quality Are the colors vibrant? Are the colors true to reality?
Country	Was it made in America?
Delivery	What are the delivery options? Does the store deliver? How much does delivery cost?
Decision	I donk know enough to make a decision for Ms. Jones
Digital	Digital screen Classic TV
Distance	How far is she sitting from the TV? What is the distance between her and the screen?
Dish	Does Ms. Jones need a dish?
DSL	Does she use DSL?
DVDs/CDs	Ability to play DVDs / CDs

Ease	Ease of use / operation (general) Simplicity of features Does she know how to use it?
Energy	What is its power consumption? How much energy does the TV use?
Exterior	What color TV does she want? Does she want a black frame? Does she want a wooden exterior? Does the color of the TV match her furniture?
Extended Programming	Does she want to subscribe to Showtime for movies? Does she want to pay for additional specialty movie channels? Is there extended programming? Can she get pay per view? HBO?
Functions / Features (general)	I would examine it's features What functions does Ms. Jones want? What different functions are on each TV? Does it fit my needs?
Fit	Does the TV fit the size of the room? Will the TV fit in her armoire? How much space there is for the TV
Fit (picture)	Will the picture fit inside the screen?
Frequency	How often does she watch TV?
Flat screen	Does she want a flat screen?
Games	Does the TV have the ability to play games on it?
Hearing	Are there additional sound features if she is hard of hearing? (does not mention Closed captioning specifically) How is hear hearing?
Headphones	Can you plug in headphones?

High Definition	Is it High Definition?
Installments	Can I pay in installments?
Kitchen	Does she want one for the kitchen?
LED/LCD	Does she want an LED screen?
Light	Light source around TV location i.e. windows that effect viewing
Livingroom	Will the TV be in the Living room? Is this her main TV for the house?
Location	Where is Ms. Jones going to put it? What room does she want it in?
Longevity	Longevity of TV How long does she need it to last?
Look	"Go and see television" (implies viewing TV in person) Looking at pictures of TV online or in person, what looks good?
Maintenance	Maintenance / repair options
Need	How much does she need a new TV? When does she need a new TV?
Netflix	Can she watch Netflix on the TV?
New	Ms. Jones should get the newest / latest model
Online	Can I order it online? I'd google pictures of it online Look for sales online
Old TV	Why does she want a new TV? What is wrong with her old TV?
Pay	WHO / HOW is going to pay for it?
Personal preference	Ms. Jones's personal opinion / preference (general) What does Ms. Jones think?

Picture	What type of picture does she want? Does she like the look of the picture?
Pixels	How many pixels per unit?
Position	Will she watch TV lying down? Is she sitting in a chair while watching TV?
Price match	What is the store's price match option?
Plasma	Does she want plasma?
Record	Does it have DVR? Can it record shows?
Recommendations	Friend's / family recommendations / advice Obtain second opinion
Remote	Has a remote control (does not mention ease of use or simplicity of remote)
Remote (ease of use)	Is the remote easy to use? Does the remote have buttons big enough to see?
Rent	You could rent a TV
Reliability	Reliability of television
Reputation	Reputation (general)
Return	Am I allowed to return it if I don't like it?
Robbery	Does the TV make someone want to break in and steal it?
Sale	I'd look for sales in the newspaper Is there a sale going on?
Salesperson	Salesman / person who works at store's advice Talk to the salesman
Satellite	Does she want satellite?

Setup	Does it have clear setup instructions? Who is going to set it up? How much do I have to pay for setup? Do they install it? What is the TV hooked up to? Do they take the old one away?
Share	Can she watch on her neighbor's / friend's / family's TV?
Size	Size of television / screen size
Sleep mode	Does it have sleep mode?
Smart TV	Does she want a SmartTV?
Sound	Sound quality How high does the volume go?
Speakers	Ability to plug in extra speakers into TV Bluetooth
Speed	How fast does it turn on?
Stand	Does the TV have a stand to put on a counter? Does the TV stand by itself?
Store	What store is she going to buy the TV at? Allegiance to store that sells TV Which store has the best prices?
Store (distance)	How far away is the store? How far do you have to go to get the TV?
Store (specific)	Is she going to buy it at BestBuy? H.H. Gregg? Sam's Club?
Quality	I would look at picture quality Is the TV good quality?
Vision	How is Ms. Jones's Vision

Voice activation	I need a TV with voice activated controls
VHS	Does the TV play VHS?
Warranty	Warranty or extended warranty options
	Is it insured?
Wall	Can it be hung on a wall?
	Is it mounted?
Widescreen	Does the TV accommodate Widescreen?

Appendix C – Question 2 Solution Core Bank

Core	Solution
Aftercare	What are the treatments' after care requirements?
Aggressive	How aggressive are the treatments? What are the most aggressive treatments? What are the most conservative treatments?
Age	How old is Ms. Jones? Considering her age, can Ms. Jones hold up to this treatment?
Alternatives	What are my alternatives, medical or non-medical? What are my alternatives? Write down summary of alternative treatments
Anesthesia	Does treatment require incapacitation / anesthesia? How long would patient be incapacitated / under anesthesia for?
Availability	What is the availability of treatment? How long will it take to get the procedure?
Avoid	Will I have to stay away from my grandchildren? Will this Isolate me from people?
Burn	Will they burn it off? Will they zap it off?
Biopsy	Is a biopsy required? What are the results of the Biopsy?
Cause	What was the cause of the skin cancer?
Caregiver	Does she have / will she need caregiver(s) to help with her recovery? Will Cindy have to take care of her? Does she need extra assistance?
Chemotherapy	Does she need chemotherapy?
Communication	How soon will patient be given answers to questions that cannot be answered now? Will information be shared with patient?

Cost	What is the cost / price of treatment? What is the cost / price of each alternative?
Common	How common is this treatment?
Cut	Will they cut it out? How big will the incision be?
Daily life	Will there be an Improvement in daily living? What activities will this treatment restrict? (words closely related to activities and suggestions of what one can and cannot do) What is the recovery's impact on daily life / quality of life? Will I still be able to bathe?
Decision	I don't think that I can make a decision for her Ms. Jones will have to decide on her treatment
Diagnosis	What is the diagnosis? What specific kind of skin cancer (benign, malignant, basal etc.)? Is it melanoma?
Doctor (advice)	Doctor's suggestion of dermatologist / specialist to have treatment done with if not them? What does the doctor advise for treatment?
Doctor (qualifications)	What is the doctor's background? What is the doctor's experience (general)? Is the doctor a specialist? Is the doctor qualified to preform the treatment? How many cases like this has doctor treated? What is the doctor's confidence / certainty of diagnosis? What is the doctor's personal success rate with treatment?
Doctor (general)	Is the doctor taking on new patients? Is the doctor satisfied with me as a patient?
Effective	How long does the treatment last? What is the rate of success for treatment? What is the chance that it is removed completely? What is the average outcome?
Experience (patient)	Has SHE ever had skin cancer removed before?

	Is this Ms. Jones's first time at the dermatologist?
Family	Talk it over with / obtain advice from family How will the treatment affect my family?
Family History	Does she have a family history of skin cancer? Is it hereditary?
Freeze	Will it be frozen off? Will they freeze it off?
Hospice	Does Ms. Jones want Hospice care?
Identify	How can I identify if I have a skin problem? How did you identify that I had a problem?
Inpatient / outpatient	Will the treatment be Inpatient or outpatient?
Insurance	Will my insurance cover this? Will the procedure be covered by Medicaid?
Invasive	How invasive are the treatments?
Lesion	Does Ms. Jones have a lesion?
Life Expectancy	How long is she expected to live?
Location	Where is the treatment received? (i.e. office, hospital, location)
Location (body)	Where is the skin cancer located?
Medication	What medications are involved? Are the medications compatible with my current medications? How do you know that I am not allergic to the medication?
Mental State	What is her mental state right now? Does she need additional counseling to make decision
Mole	Did Ms. Jones have a mole that was cancerous?

No treatment	What happens if I get no treatment? What are the risks of getting no treatment? How long do I have to live if I don't get treatment?
Paperwork	Who takes care of the paperwork?
Pain	How painful is the procedure?
Physical state	How is her physical state? Is she healthy enough to undergo surgery?
Physical Therapy	Is physical therapy required?
Plastic Surgery	Will she need plastic surgery?
Prognosis	What is the prognosis? Will it spread? What is going to happen? What is the likely course of the disease? Is it curable? / Is there a cure?
Preference	What is Ms. Jones's preference? What is Ms. Jones's personal opinion?
Preparations	Preparations / pre-surgical / pre-treatment requirements?
Prevention	What can I do to prevent this from reoccurring?
Radiation	Do I need to get radiation?
Recovery	How long is the recovery / recuperation time? How will she feel afterwards?
Research	Where can I find references to studies / pamphlets / educational information on treatment types? I would look at the background research
Relationships	How will this effect my relationships with people?
Return	Which has the least chance / possibility of / rate of cancer returning after treatment?

Risks	Potential complications / risks of treatment? Chances that this will occur again? Risk of the cancer spreading?
Scarring	Which treatment will be least scarring? Will there be scaring?
Stitches	Are stitches needed?
Second opinion	May I obtain second opinion? Who / where does the doctor recommend I get a second opinion from? Obtain second opinion about doctor Obtain second opinion about treatment from other patients
Severity	How severe is it?
Size	How big is the cancerous area?
Side Effects	What are the side effects of treatments? How severe are the side effects of the treatments?
Speed	How fast is it growing? Define "slow-growing" How slow is it growing? Can it be caught in time?
Sun	Was it caused by too much sun exposure? Should I wear more sunscreen?
Surgery	Is surgery needed?
Symptoms	What where the symptoms?
Test	What kinds of tests are preformed?
Time	How soon do I need to get the procedure done? How many visits are required for treatment? How long does the treatment take? Scheduling treatment
Transportation	How will I get to the treatment location?

	Can I drive myself to the hospital?
Treatment	What are the different modes of treatment?
	How will it be removed (general)?
	What are the pros and cons of each treatment?
Wait	Does it hurt to wait?
	Dangers in waiting to get the treatment done?