Published in final edited form as:

J Neurosci Nurs. 2012 February ; 44(1): 43–53. doi:10.1097/JNN.0b013e31823ae48b.

An Overview of Non-pathological Geroneuropsychology: Implications for Nursing Practice and Research

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Abstract

One aspect of successful aging is maintaining cognitive functioning; that includes both subjective cognitive functioning and objective cognitive functioning even in lieu of subtle cognitive deficits that occur with normal, non-pathological aging. Age-related cognitive deficits emerge across several domains including attention, memory, language, speed of processing, executive, and psychomotor, just to name a few. A primary theory explaining such cognitive deficits is cognitive reserve theory; it posits that biological factors such as demyelination and oxidative stress interfere with neuronal communication which eventually produces observable deficits in cognitive functioning. Therefore, it is important to maintain or improve cognitive reserve in order to augment cognitive functioning in later life. This article provides a general overview of the principles of geroneuropsychology along with implications for nursing practice and research.

Keywords

Successful Aging; Memory; Executive Functioning; Psychomotor; Mild Cognitive Impairment

INTRODUCTION

There are several definitions of successful aging, and all include some aspect of cognitive functioning (e.g., Baltes & Baltes, 1990; Kahana & Kahana, 2001; Pruchno, Wilson-Genderson, & Cartwright, 2010). In Rowe and Kahn's (1997) definition of successful aging, three components are required: (1) avoiding disease and disability, (2) active engagement in life, and (3) maximizing physical and cognitive function. Clearly, these three components are interrelated and support each other; however, optimal cognitive function is essential in maintaining the other two components of successful aging. Studies show that adults with suboptimal cognitive functioning are more likely to be less adherent to medication schedules and other disease prevention activities (e.g., Hinkin et al., 2004; Reppermund et al., 2010). Likewise, optimal cognitive functioning is needed to pursue leisure activities, drive an automobile, interact with others, and negotiate one's environment. In their study of 4,077 community-dwelling older adults ($M_{age} = 76$), McGuire, Ford, and Ajani (2006) found that poorer cognitive functioning was predictive of poorer instrumental activities of daily living (IADLs) such as using the telephone, managing finances, and grocery shopping.

Physical health and comorbid conditions also affect cognitive health; unfortunately, concerns about physical health often eclipse cognitive health until one's cognitive functioning begins to decline (Vance, Eagerton, Wright, & Larsen, in press). Yet, with advancing age, non-pathological cognitive deficits also occur which can hinder one's ability to age successfully. Even minimal deficits occur across several cognitive domains including attention, memory, language, speed of processing, executive, and psychomotor. Such subtle cognitive deficits can impair IADLs and reduce independence, mobility, and quality of life.

This overview of geroneuropsychology will focus on the basic distinctions of cognition as they relate to non-pathological aging. Following this, cognitive aging will be examined within the context of neuroplasticity and cognitive reserve. From this, implications for nursing practice and research will be provided.

COGNITIVE DOMAINS

Cognition remains an elusive concept to study because it is a global construct with many unique forms of expression. Figure 1 provides a basic rubric showing the features of cognition starting with the first major distinction between crystallized and fluid intelligence and the various pathways in which fluid intelligence is composed of several distinct cognitive abilities and how these abilities in turn form crystallized intelligence. In this figure, the solid lines from fluid intelligence are drawn to each of the fluid abilities of attention, memory, language, speed of processing, executive, and psychomotor. Within these fluid abilities, there are yet even further distinctions which are well beyond the scope of this article. From these fluid abilities, knowledge and skills are obtained which form crystallized intelligence (Facon, & Facon-Bollengier, 1999; Kay, 2005); this is highlighted by the broken lines leading from these fluid abilities to crystallized intelligence. These collective abilities compose cognition which is necessary for everyday functioning. More detailed distinctions among the model constructs are provided below.

Fluid Intelligence and Crystallized Intelligence

The largest distinction in cognition is between fluid intelligence and crystallized intelligence; these major types of intelligence are conceptualized as functioning within different neural pathways, although there is interaction between the two types. Fluid intelligence refers to one's innate cognitive abilities that are categorized with several domains: attention, memory, language, speed of processing, executive, and psychomotor. Fluid intelligence also refers to the integration of these cognitive domains. These abilities

emerge over time and become, more or less, automatic. They are necessary for processing new sensory information, recognizing patterns, assimilating and accommodating new information, and problem solving in order to navigate one's environment (Ball, Vance, Edwards, & Wadley, 2004; Kay, 2005). In general, fluid intelligence is considered to be more vulnerable to age-related deficits than crystallized intelligence. Performance in the cognitive domains of attention, memory, and so forth, generally develop to peak performance in one's 30's and then gradually decline with age (Ball et al., 2004; Papalia, Camp, & Feldman, 1996).

In contrast, crystallized intelligence refers to the accumulated knowledge and skills developed through the use of fluid intelligence abilities (Ball et al., 2004; Kay, 2005). Such knowledge and skills include riding a bike, speaking a language, balancing a checkbook, and general knowledge about the world. Obviously, crystallized intelligence increases with enriching life events such as advanced education, traveling, engagement in stimulating leisure time activities, and social contact with others. Crystallized intelligence grows with age as people live longer and gather more information along the lifespan.

Attention

Attention refers to one's ability to sustain focus while avoiding distractions and discriminating between relevant and irrelevant details. Obviously, attention is a foundational cognitive ability, closely tied to both memory and executive functioning. Attention is needed to commit something to memory; likewise, attention is required to direct executive functioning abilities (Papalia et al., 1996) as well as other cognitive abilities.

In the information processing model, information to be remembered enters through the senses and is held in sensory memory for just 1 to 2 seconds. This information is then transferred to short-term memory where it is rehearsed (i.e., processed over and over); once the information is rehearsed sufficiently to be encoded and memorized, it is then transferred into one's long-term memory where it can be retrieved upon command. For this information processing to occur, attention must be focused on the information from start to finish. One must attend to the information received in one's sensory memory, attend to the information being rehearsed, and then attend to retrieving the information from long-term memory (Papalia et al., 1996). The domain of executive functioning also plays a role in directing attention to accomplish the goal of remembering and retrieving information. In fact, the study of age-related deficits in selective attention has been done with experiments involving executive functioning which demonstrates that if attention is compromised, executive functioning is also compromised and vice versa (Schmitz, Cheng, & De Rosa, 2010). With increasing age, the ability to maintain attention becomes more compromised, which may also contribute to the declines observed in other cognitive abilities (Vecera & Rizzo, 2004).

Memory

Memory appears to be the most salient cognitive domain in which people notice such cognitive changes with age. Low and colleagues (2004) found that in a sample of 131 community-dwelling older adults without dementia that one-third exhibited signs of memory deficits. In a sample of 114 community-dwelling older adults ($M_{age} = 66.2$), Minett, Silva, Ortiz, and Bertolucci (2008) found that 21% reported memory complaints. Such subjective ratings in memory often correspond with observable, testable, objective assessments of memory.

There are several types of memory as noted in the information processing model, including sensory memory, working memory (a.k.a., short-term memory), and long-term memory. Sensory memory consists of that 1 to 2 seconds in which information is processed and is

transferred to working memory. Working memory refers to ability to recall information from recent experience (e.g., sensory memory) as well as storage of such memory and the recall of information from long-term memory. By analogy, it is considered the chalk board on which information is processed in the here and now. It can only hold a certain amount of information at any given time, while long-term memory is considered more a library of information. With age, this chalk board (i.e., working memory) becomes smaller; in other words, the brain becomes less efficient in holding several facts at the same time in one's consciousness (Ball et al., 2004).

Long-term memory is composed of two major classes declarative and nondeclarative. Declarative memory, sometimes referred to as explicit memory, refers to information that can be "declared" such as personal knowledge about one's holiday or a trip abroad (i.e., episodic memory) or general knowledge such as knowing that Ottawa is the capital of Canada (i.e., semantic memory) (Ball et al., 2004). In a typical study of explicit memory (especially verbal (a.k.a. semantic) memory), Backman and Wahlin (1995) presented two lists of words to a sample of 224 older adults between 75 and 96 years old and asked them to recall as many words as they could. In one list, the words were semantically unrelated (e.g., car, apple, table). In the second list, the words were semantically related and could be organized by three categories such as an article of clothing, a musical instrument, or a plant (e.g., sock, trumpet, daisy, shirt, flute, violet). Although all participants were able to recall words more often by organizing them by category, these researchers found that being older was related to fewer words being freely recalled.

Nondeclarative memory refers to unconscious or unintentional recall of information, often of a psychomotor ability such as riding a bike or using a spoon, but can refer to recall of information in which one was unaware of learning. This is sometimes referred to more broadly as procedural memory or implicit memory (Ball et al., 2004; Papalia et al., 1996). As tested in studies using a priming technique in which the information to be recalled is presented before hand in subtle and less obvious manner, declarative memory is more prone to age-related losses than nondeclarative memory (Fleischman, Wilson, Gabrieli, Bienias, & Bennett, 2004).

Executive

Executive functioning refers to a variety of cognitive abilities used to coordinate other cognitive domains in order to problem solve, organize, reason, inhibit impulses, switch attention, and plan. One theory of cognitive aging, the frontal aging hypothesis, posits that the frontal and prefrontal cortex which houses the neural circuitry of executive functioning experiences differential age-related atrophy compared to the other parts of the brain. As damage to these areas reduces executive functioning, the overall cognitive abilities of older adults are compromised and deficits occur (Ball et al., 2004). In the Women's Health and Aging Study II, which documented declines in cognitive domains over a 9-year period, deficits in executive functioning preceded deficits in memory functioning (Carlson, Xue, Zhou, & Fried, 2009). Other studies report similar findings. For example, when using positron emission tomography (PET) scans to show how much older and younger participants use the prefrontal cortex during a complex memory task, older adults are shown to have more over activation of this brain region than younger adults to accomplish the same task (Cappell, Gmeindl, & Reuter-Lorenz, 2010). Such findings demonstrate age-related compensation for such loss in the frontal lobes and executive functioning.

Speed of Processing

Speed of processing refers to the rate at which information is processed; the faster information is processed, the less likely it is to degrade along the way due to lack of

sustained attention or poor working memory. Thus, as in computer processing speed, speed of processing is considered a foundational cognitive ability upon which other cognitive abilities depend. In fact, the diminished speed of processing theory posits that deficits in speed of processing precede deficits in other cognitive domains; support for this proposition has recently been demonstrated (Finkel, Reynolds, McArdle, & Pedersen, 2007; Vance, 2009).

Speed of processing can be measured in several ways, whether through assessment of how quickly calculations are performed or problems are solved, or more basically, the speed at which auditory, or visual information is processed. In studies of visual speed of processing, researchers have used a measure called the Useful Field of View[®] test to show that with age, older adults gradually lose the ability to quickly absorb and process visual information efficiently (Ball, Edwards, & Ross, 2007; Vance, 2009). Such visual speed of processing is important given that reductions in the Useful Field of View[®] test have been shown to be related to automobile crashes in community-dwelling older adults.

Language

There are many aspects of language to consider. Two important areas for understanding the effect of aging on language are naming ability and vocabulary. Naming ability is considered a fluid ability because it draws upon several mental resources to spontaneously derive a name for something. As these cognitive resources become compromised with age, deficits in naming ability emerge. For example, Au and colleagues (1995) administered the Boston Naming Test to 53 normal adults 30 to 79 years old three times over a 7-year period. In this test, participants were instructed to look at pictures and come up with the correct name for the object in the pictures. These researchers found the ability to produce the correct name for the objects declined over time with such deficits in naming ability being more observable in older participants. Similar findings have been reported (e.g., Albert et al., 2009).

Although deficits in language processing are observed with aging, studies show one area of language, vocabulary, not only is maintained, but increases with age. As a rule, older adults possess a stronger and richer vocabulary than younger adults (Papalia et al., 1996; Camp & McKittrick, 1989). The most likely reason for this is that as people age, they are exposed to more words through years of talking to others, reading books and other printed materials, and listening to the media. Also, vocabulary is a form of crystallized intelligence (i.e., learned information) which generally increases with education and exposure to language. However, even though older adults may know more words, they experience more “tip-of-the-tongue” episodes in that it may take them longer to recall the word in which they want to use (Papalia et al., 1996).

Psychomotor

Psychomotor functioning refers to reaction time (e.g., such as reacting to stimuli in a driving simulator), fine motor movements (e.g., sewing, buttoning a shirt), and gross motor movements (e.g., raising one’s hand, lifting one’s foot). Studies demonstrate that these abilities decline with age (Godefroy, Roussel, Despretz, Quaglino, & Boucart, 2010). In fact, one particular theory of cognitive aging, the common cause hypothesis, posits that cognitive changes in different domains parallel each other such that deficits in psychomotor ability, executive function, memory, etcetera, are due to the fact that there is a common mechanism that is affected (Ball et al., 2004). In a study of 3,769 older adults (65 to 85 years), Soumare and colleagues (Soumare, Tavernier, Alperovitch, Tzourio, & Elbaz, 2009) found that a deficit of gross psychomotor functioning (i.e., maximum walk speed) was significantly related to deficits in executive, memory, and fine psychomotor ability. Such parallel age-

related deficits in these cognitive domains including psychomotor ability support the common cause hypothesis.

COGNITIVE RESERVE

As alluded, there are a variety of hypotheses and theories that explain cognitive aging (e.g., frontal aging hypothesis, diminished speed of processing theory, common cause hypothesis); however, they all share similar characteristics with the cognitive reserve hypothesis which asserts that damage to the brain results in compromised cognitive ability. More specifically, cognitive reserve refers to the amount and sophistication of connections between neurons from which cognitive functioning emerges (Milgram, Siwak-Tapp, Araujo, & Head, 2006). Generally, the more intricate and richer these connections are, the better one's cognitive functioning. Such connections are also perceived to protect one from age-related cognitive deficits. As neuronal connections become severed by damage to neurons through apoxia-related events, poor nutrition, oxidative stress, and other causes, the remaining connections can take over and resume normal functioning so that cognitive functioning is uninterrupted. However, as neural connections become more fragmented and brain regions experience difficulty with reliable neural communication, cognitive reserve is believed to weaken and cognitive deficits emerge (Milgram et al., 2006; Vance, Roberson, McGuinness, & Fazeli, 2010).

Based on principles of learning theory and glial activation in the brain (Fields, 2009; Vance et al., 2010), cognitive reserve is supported or undermined by the process of positive neuroplasticity and negative neuroplasticity, respectively. Positive neuroplasticity refers to the process by which connections between neurons are formed; this is usually observed in stimulating, novel, and physiologically supportive environments. In contrast, negative neuroplasticity refers to the process by which connections between neurons are not supported or severed; this is usually observed in non-stimulating and physiologically non-supportive environments (Vance et al., 2010). In a geriatric setting such as a nursing home, this is seen in patients who are either provided interesting activities to engage such as musical events, arts and crafts, and social activities (i.e., positive neuroplasticity) or left alone, unstimulated, and unengaged (i.e., negative neuroplasticity). As neuronal connections are formed, cognitive reserve increases; conversely, as neuronal connections are severed, cognitive reserve decreases. Positive and negative neuroplasticity are readily observed in a variety of animal and humans studies (e.g., enriched environmental paradigm, magnetic resonance imaging (MRI) studies) which show exposure to novel stimuli changes brain morphology and chemistry.

In animal studies, positive and negative neuroplasticity has been shown in various permutations of the enriched environmental paradigm (Diamond, 1993; Lu et al., 2003). In this experimental paradigm, genetically similar rats (i.e., from the same colony) are randomly assigned to one of three environments: impoverished, standard, and enriched. In the impoverished environment, rats are placed by themselves in a cage with no other rats or toys with which to interact. This impoverished environment reflects negative neuroplasticity. In the standard environment, rats are placed in groups of three to a cage; although they can interact with each other, they have no toys with which to interact. In the enriched environment, rats are placed in groups of 12 to a cage so they can interact with each other and also have toys with which to interact. In fact, these toys are exchanged at regular intervals with new toys to create novelty. This enriched environment reflects positive neuroplasticity. When examining the brains of these rats after exposed to these environmental conditions, the rats in the enriched environment had larger brains and more dendritic connections than those exposed to impoverished or standard environments (Diamond, 1993). Likewise, rats in the standard environment had larger brains and more

dendritic connections than those exposed to the impoverished environment. Moreover, researchers found that rats exposed to the enriched environment performed better than rats in the other two conditions on various maze tasks which approximate cognitive functioning (Kobayashi, Ohashi, & Ando, 2002; Paban, Jaffard, Chamben, Malafosse, & Alescio-Lautier, 2005).

In human studies, the effects of positive and negative neuroplasticity on cognitive reserve and cognitive functioning are also observed. Boyke, Driemeyer, Gaser, Buchel, and May (2008) examined the morphological changes in a sample of 25 older adults ($M_{age} = 60$) who learned how to juggle. Magnetic resonance imaging (MRI) scans were conducted at baseline (i.e., before they started to learn to juggle), at three months (i.e., when they mastered a three-ball-cascade juggle for at least 1 minute), and then three months later (i.e., after participants had not practiced juggling). The MRI scans from baseline to the peak of juggling displayed an increase of gray matter volume of the nucleus accumbens and hippocampus (e.g., brain structures required for the consolidation of memory engrams), thereby exemplifying positive neuroplasticity. Similarly, the MRI scans from the peak of juggling to three months later during juggling cessation displayed a loss of volume of the same brain structures, exemplifying negative neuroplasticity.

The effect of neuroplasticity on cognitive reserve has also been proposed as a mechanism that can be targeted for intervention to delay the onset of Alzheimer's disease and related dementias. Richards, Hardy, and Wadsworth (2003) proposed that active engagement in leisure time activities is tantamount to positive neuroplasticity. In a large national cohort of adolescents, they examined whether engagement in leisure time activities (e.g., playing chess, musical instruments) was protective of cognitive functioning in later life. Controlling for gender, educational level, socio-occupational status, mental distress, and intelligence quotient at adolescence, they found greater engagement in leisure time activities during adolescence was predictive of better cognitive functioning, especially memory, at middle age (i.e., 43 years).

In a related study using PET scans, Roe and colleagues (2008) used radiotracers to determine the amount of fibrillar beta-amyloid pathology in older adults. Normally, such beta-amyloid pathology is observed with advancing age and much more so with Alzheimer's disease; it is considered one of the causes and hallmarks of the neurological manifestations of cognitive deficits because it severs connections between neurons. In this study, education is considered a novel environmental stimulus and as a proxy measure of cognitive reserve. As adults received acquire more education, this promotes positive neuroplasticity which over time encourages the development of more cognitive reserve. Thus, it is hypothesized that even when amyloid plaques disrupt communication between neuron, with the accumulation of cognitive reserve, other neurons can re-route such information and therefore delay the cognitive impact of Alzheimer's disease. Roe and colleagues found that those with higher levels of education exhibited better cognitive functioning (i.e., Animal Naming test, $p = .003$; Trailmaking B test, $p < .001$; and WAIS-III Similarities subtest, $p < .001$) than those with lower levels of education, even when beta-amyloid pathology was present. This finding suggests that higher levels of education may delay the cognitive symptoms of Alzheimer's disease, even when such hallmark biological pathology is detected. Other studies show similar results in delaying the cognitive symptoms of Alzheimer's disease (Engelman, Agree, Meoni, & Klag, 2010).

IMPLICATIONS FOR NURSING PRACTICE

An understanding of age-related cognitive deficits, cognitive reserve, and neuroplasticity is important for gerontological nurses to provide support to older patients. Although some

degree of age-related cognitive decline is a part of normal aging, this does not mean that it is necessarily inevitable for everyone to experience cognitive deficits that impair everyday functioning. There are individual differences in cognitive decline, with some people aging very well cognitively while others are more susceptible to cognitive deficits. Fortunately, evidence now demonstrates that interventions and strategies such as cognitive remediation therapy and lifestyle choices can actually improve and maintain cognitive health in older adults.

Cognitive remediation therapies continue to be developed in order to improve global cognition and particular cognitive domains such speed of processing and memory. For example, to improve visual speed of processing, Edwards and colleagues (2005) randomly assigned 126 community-dwelling older adults to either a visual speed of processing condition or a social-contact control Internet training condition. In the active experimental condition, 10 hours of visual speed of processing exercises were administered on the computer. During these exercises participants had to quickly absorb visual information presented within 17 to 500 ms and respond with the correct answer. If they did not respond correctly, the presentation time was slowed; if they responded correctly, the presentation time was faster. This forced participants to reach their visual speed of processing threshold in order to improve their ability. In the control condition, participants received 10 hours of social contact and computer exposure while they were taught how to use the Internet, send e-mails, “surf” the web, and so forth. Using a pre-post experimental design, researchers found that, in comparison to the control group, those in the visual speed of processing group improved on a measure of visual speed of processing (i.e., Useful Field of View®) and a functional measure (the Timed IADL test). Interestingly, subsequent studies also show that improving the Useful Field of View® using this training technique improves driving performance, health-related quality of life, and locus of control (Ball et al., 2007).

Other training approaches to improve memory have been tested, but with limited success. For example, in a sample of 265 community-dwelling older adults, McDougall and colleagues (2010) assigned participants ($M_{age} = 75$) to either a memory training intervention or a health promotion training comparison (control) group for a 24-month period. At baseline, participants could not have Hodgkin’s disease, neuroblastoma, Alzheimer’s disease or related dementias, or lung, brain, or liver disease; also participants had to have adequate vision and hearing and function within a normal cognitive range as judged by a the Mini-Mental Status Exam (23 or higher). The memory training consisted of a small group format in which internal and external memory strategies and exercises were performed; educational lectures about memory were also provided. The researchers found that those assigned to the memory training condition improved on measures of memory complaints and global cognition; however, measures on objective memory performance and IADLs did not improve. Regardless, such cognitive remediation techniques show promise in ameliorating cognitive deficits in lieu of age-related cognitive changes. Many cognitive remediation therapies are now being administered via computer with very good results; however, not all of these programs are evidence-based. Recommendations for use of a particular computer-based remediation program should only be made with caution after examining the literature as to which ones are effective (Vance, McNees, & Meneses, 2009).

Healthy lifestyle choices have also been found to promote cognitive health (Milgram et al., 2006). Numerous studies have shown that moderate exercise, a balanced diet including higher levels of antioxidants and omega 3 fatty acids, stimulating activities such as playing a musical instrument, intellectually challenging work, low to moderate alcohol use, and stress reduction contribute to cognitive health (Milgram et al., 2006; Vance et al., 2010). In fact, Vance, Eagerton, and colleagues (in press) proposed a simple method of incorporating healthy lifestyle choices into a behaviorally-oriented cognitive prescription. Using

motivational interviewing techniques, nurses can help patients set individualized exercise goals, dietary goals, intellectual goals, and other such goals in order to develop a cognitive prescription. The purpose of the cognitive prescription is to not only promote cognitive health over the lifespan, but to improve general quality of life as well. However, cognitive prescriptions focusing on lifestyle choices are not a quick fix for subjective memory loss; cognitive prescriptions may achieve the benefits of being neuroprotective against age-related cognitive deficits only after a course of years.

Despite our best efforts, many patients will still develop age-related cognitive deficits. Therefore, it is important to develop compensatory strategies for coping with such deficits. Some patients who are less satisfied with their memory may resort to using external mnemonics such as calendars, making lists, or posting “to be remembered” items on their refrigerator. In our technological age, numerous gadgets, cell phones, and so forth can be used to help compensate for memory problems. Other, more basic, mnemonic techniques can also be used to help memorize information (e.g., method of loci, chunking, levels of processing, and spaced-retrieval method) (see Vance, Webb et al., 2008). These mnemonic techniques are inexpensive, easy to use, and do not require any special training. Many of these are already used informally. For example, the method of loci is one that has been used by students for decades. For example, if one needed to learn the date of a historical event such as when the Treaty of Versailles was signed, one can visualize the numbers of the date along the sequence of a familiar path (e.g., 28 at the beginning of the path, 6 next to the big tree, and 19 at the end of the path); thus, one would have the numbers 28-6-19 or 28th of June 1919. Such compensatory strategies do not have to be overly complex and can be applied to a number of everyday situations.

When patients present cognitive complaints, it is reasonable to be instructive about how to compensate for such normal age-related cognitive deficits and assuage concerns that such deficits are normal; however, it is also important to document such complaints and observe whether the deficits become more severe over time. Many patients will develop amnesic Mild Cognitive Impairment (MCI) which is considered to be a preclinical stage of dementia, with 23% eventually developing Alzheimer’s disease within two years of the MCI diagnosis (Nordlund et al., 2010). Vance, Farr, and Struzick (2008) proposed a nursing framework of how to document and track such cognitive problems through the use of asking patients or family members about such deficits, observing if patients forget appointments, and more objectively through the use of brief cognitive screeners such as the Mini-Mental State Examination (MMSE; Folstein, Folstein, & McHugh, 1975). For example, the MMSE is a widely used screener to examine global cognition. It takes approximately 5-10 minutes to administer; during this test, items are scored on orientation (e.g., Where are you? What is it today?), reading, comprehension, spatial orientation and drawing, and following directions. Scores range from 0 to 30; scores less than 24 are indicative of those developing dementia or already have dementia. Since many older patients have excellent social skills which can hide their cognitive deficits; such cognitive screeners can help reveal whether such cognitive deficits are progressive. If evidence indicates that patients are performing progressively worse, then the medical team can make the appropriate referral to a neurologist or psychologist.

IMPLICATIONS FOR NURSING RESEARCH

As the population has grown older, the field of geroneuropsychology has grown immensely as exhibited by the number of articles, journals, and conferences dedicated solely to this topic. Within geroneuropsychology, there are a number of research related issues that need to be addressed including the consent process, measurement and instrumentation, the

influence of comorbidities, the cognitive side of wisdom, and understanding the role of cognitive reserve in lieu of pathological aging.

First, the process of informed consent in research must be considered within the context of geroneuropsychology. Some older adults will continue to have outstanding fluid cognitive abilities while others will undoubtedly be functioning much worse than others their age. Subtle, and sometimes more obvious, cognitive deficits have important considerations for older research participants. Many research protocols target older adults who have comorbidities that may also negatively impact cognitive functioning. Such research protocols and corresponding consent forms may be overly complex; such complexity can either discourage older adults from participating or they may be consenting to a protocol they do not fully understand (Mayo & Wallhagen, 2009). As people age, fear and stigma exist about declining cognitive abilities and many older adults may acquiesce to the consent process in order not to reveal their true cognitive condition.

Second, to conduct research in geroneuropsychology, one requires familiarization with the measures and instruments needed to objectively quantify particular cognitive domains and abilities. In neuropsychology, it is accepted that there is no “true” test of any particular cognitive ability because every test assesses several cognitive abilities. For example, in a test of memory, one might be asked to recall a list of words. In doing so, attention and language skills are also employed. This “bleed over” effect is unavoidable and accepted within neuropsychology; however, such measures are designed to minimize the use of irrelevant cognitive abilities and maximize the use of the cognitive domain being measured. These instruments can be administered in several ways including pencil and paper, computer program, audiotape, and so forth depending on the particular cognitive ability that is being studied. Table 1 provides a sample of such instruments that nurse researchers may use to examine the major cognitive domains presented in this article; all the instruments listed have good test-retest reliability and validity and many are age-normed (Ball et al., 2004; Lezak, 1995).

Third, age-related cognitive deficits are being examined more within the context of comorbidity and multi-morbidity. With advanced age, the body becomes more prone to developing chronic conditions such as diabetes, heart disease, and hypertension which can also compromise cognitive health (Vance, Larsen et al., in press). Aging with a chronic condition is also becoming the focus of research in geroneuropsychology instead of just studying the effects of aging on cognition alone. For example, with the advances in treatment of HIV, researchers are finding that those aging with HIV are more susceptible to cognitive deficits compared to their HIV-negative age-matched counterparts (Vance, Larsen et al., in press).

Fourth, wisdom (e.g., insight, creativity) is considered by some to be a cognitive domain in which many older adults are thought to possess great reservoirs. Albeit, this area is difficult to study due to conflicting operational definitions and lack of measures for these concepts. However, findings from a recent study of wisdom indicate that this concept may be a blend of both highly developed cognitive and emotional functioning derived from experience (Jeste et al., 2010). Studies of wisdom are surfacing along with exciting research of emotional intelligence (Mayer, Salovey, & Caruso, 2008).

Finally, evidence of whether an accumulation of cognitive reserve can actually delay the onset of Alzheimer’s disease is being examined. As mentioned, much evidence supports this position (e.g., Richards et al., 2003). In fact, some studies suggest that bilingualism is a form of cognitive reserve and present data to support this assertion (e.g., Craik, Bialystok, & Freedman, 2010); however, not all studies agree. Operating on the idea that being able to

speak and write a complex second language such as Japanese may increase cognitive reserve and protect against age-related cognitive deficits, Crane and colleagues (2010) examined the cognitive functioning of a large sample ($N = 2,520$) of second generation Japanese-Americans in Oahu, Hawaii over a decade. Controlling for age, education level, income, apolipoprotein E4 allele status, smoking, and number of study visits in a mixed effects modeling approach, rate of cognitive decline was not differentiated between those who were and were not proficient in speaking and writing Japanese. These findings are inconsistent with existing data that supports the cognitive reserve hypothesis. Clearly, the theoretical and methodological issues are complex and require further study.

CONCLUSION

The direction of this article was to provide nurses, both clinicians and researchers, with an updated review of non-pathological geroneuropsychology to augment and compliment their existing education, training, and experience. The information was provided to show a balanced view of two sides of the issue. On one side, despite individual differences, subtle age-related cognitive deficits are the norm. On the other side, there are techniques and lifestyle factors to consider in helping patients to maintain cognitive health.

The view of pathological aging was not considered in depth in this article. Clearly, pathological aging is of vital importance as nurse researchers and nurse clinicians attempt to study and maintain cognitive functioning in adults with Alzheimer's, Lewy-body, Huntington's, and Parkinson's diseases. To understand pathological cognitive aging, an overview of the normal nonpathological geroneuropsychology is needed for comparison purposes.

Finally, several novel areas of geroneuropsychology research were highlighted. In particular, cognitive remediation therapies hold promise as an approach to ameliorate age-related cognitive loss. This area of research will eventually become more important to patients as such computer programs become more widely available and easier to use (Vance et al., 2009). Patients will be looking to nurses to provide information on cognitive remediation therapy and other techniques to promote successful cognitive aging.

Acknowledgments

This article was written with partial support from the University of Alabama at Birmingham's Center for Translational Research on Aging and Mobility Project (Grant No. 2 P30 AG022838-06).

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Figure 1.
Cognitive Domains.

Table 1**Sample of Cognitive Instruments by Cognitive Domain**

Cognitive Domain	Sample Cognitive Instruments
Attention	Mattis Dementia Rating Scale – Attention
	Trails A (sometime considered a measure of psychomotor ability)
	WAIS Digit Symbol Substitution
	WMS-III Letter-Number Sequencing
Executive	CLOX 1 (clock drawing test)
	Controlled Oral Word Association Test (Letter and Category subtest)
	Digit Symbol Substitution
	Figural Relations
	Raven's Progressive Matrices
	Trails B
	Wisconsin Card Sorting Test
Language	Boston Naming Test
	Controlled Oral Word Association Test (Letter and Category Fluency subtests)
	WMS-III Vocabulary
	WRAT-III Reading
Memory (verbal)	California Verbal Learning Test
	Hopkins Verbal Learning Test
	Mattis Dementia Rating Scale – Memory
Psychomotor (Fine)	Halsted-Reitan Finger Tapping Test
	Trails A (sometimes considered a measure of attention ability)
Psychomotor (Gross)	Turn 360
	Timed Get Up and Go Test
	25 Foot Walk
	6-Minute Walk
Speed of Processing	Complex Reaction Time Test
	Finding As
	Letter and Pattern Comparison
	Useful Field of View [®] Test
	WAIS Digit Substitution

Notes. WAIS = Wechsler Adult Intelligence Scale; WMS = Wechsler Memory Scale; WRAT = Wechsler Reading Achievement Test.