Chapter 1

Introduction and Theoretical Perspectives

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Introduction

With the rapid aging of populations in the United States and in many countries around the world, there is a need for speech-language pathologists (SLPs) to know what is considered normal for older adults in terms of cognitive-linguistic, motor speech, voice, and swallowing abilities. This need coincides with the continuing quest for evidence-based practice (EBP) in the field of speech-language pathology (Reilly, Douglas, & Oates, 2004). Having normative data will help SLPs meet the EBP guidelines described in a position statement developed by the American Speech-Language-Hearing Association (ASHA, 2005). The position paper in part states that professionals must recognize the needs and abilities "of individuals and families to whom they provide clinical services, and integrate those factors along with best current research evidence and their clinical expertise in making clinical decisions." In addition, SLPs need to "acquire and maintain the knowledge and skills that are necessary to provide high quality professional services, including knowledge and skills related to evidence-based practice" (ASHA, 2005, p.1).

Thus, the information presented in this book is meant to help SLPs make decisions about assessment and treatment protocols for their elderly patients. Professionals must also learn how to view the health of aging adults in a much broader fashion using the World Health Organization's (WHO) *International Classification of Functioning, Disability, and Health*.

Chapters 2 through 8 of this book are organized in a similar format: for each topic, older adults' general abilities are presented, followed by a description of factors that negatively affect those abilities, and signs of problems that warrant referrals to professionals. Helpful strategies for dealing with these problems are then discussed. The final chapter discusses the WHO framework and its application to the aging population. Each chapter concludes with a list of "Quick Facts" summarizing key points, as well as a set of discussion questions. A Glossary of potentially unfamiliar terms is included, as well as an Appendix that lists tests SLPs can use to evaluate their adult clients. Pros and cons of each test are presented. This current chapter gives operational definitions pertinent to the book, and it presents theoretical perspectives regarding age-related changes affecting cognition and language. As with the other chapters in this book, "Quick Facts" and discussion questions are included at the end.

Operational Definitions: Healthy and Older

What is healthy? At what age is one considered *older*? Although both terms seem to be easily understood, in actuality, finding adequate definitions is somewhat challenging. Many research studies include healthy older adults as participants, but very few actually state what they mean by *healthy*. Similar to what other authors do (Cohn, Dustman, & Bradford, 1984; Collie, Shafiq-Antonacci, Maruff, Tyler, & Currie, 1999; Meijer, De Groot, Van Boxtel, Van Gerven, & Jolles, 2006), in this book we use *healthy* to refer to the lack of any kind of neurological disease or disorder, such as stroke, dementia, or progressive diseases such as Alzheimer's disease and multiple sclerosis, that would presumably interfere with the abilities discussed (e.g., auditory comprehension, swallowing). However, some investigators use additional criteria when classifying their healthy older adult groups. For example, Collie and colleagues (1999) stated that participants in their study could not have epilepsy, diabetes, thyroid disease, major depression/anxiety, or other psychiatric illness. Carlson, Fried, Xue, Bandeen-Roche, Zeger, and Brandt (1999) included aging adults who were physically high functioning and cognitively intact in their study. The absence of neurological damage is key because its presence, even if seemingly resolved, as in the case of transient ischemic attacks (Shankle & Amen, 2005), can easily affect the abilities described in this book. In some cases, researchers use the terms

normal or *neurologically intact* synonymously with the word *healthy* (Peel, Bartlett, & McClure, 2004).

Defining *aging* or *older* is not any easier. Qualifications seem to span the gamut. Many people are quite surprised when they receive their first complimentary issue of the AARP (American Association of Retired Persons) magazine at the age of 50. Many 70-year-olds feel as energetic and healthy as ever and believe the number of birthdays they have celebrated does not necessarily reflect the vitality they feel (Stephens, 1991). Research articles are not any more helpful. Some studies classify older adults as being in their 50s and older (Constantinidou & Baker, 2002; De Beni, Palladino, Borella, & Lo Presti, 2003; Federmeier, Van Petten, Schwartz, & Kutas, 2003), while other investigations consider individuals "older" at age 65 and above (Gordon-Salant & Fitzgibbons, 1999; Little, Prentice, Darrow, & Wingfield, 2005; Pichora-Fuller, Schneider, & Daneman, 1995). Many studies do not specify a maximum age, allowing adults in their 80s and 90s to participate (Burda, 2007, 2008; De Beni et al., 2003; Kemper, 1986; Parkin & Java, 1999). The classifications of young-old, middle-old, and old-old can also be used and typically begin at age 65 and progress upward (Burda, 2007, 2008; Schmitt, 1983). For this book, *aging* and *older* in general refer to individuals who are age 65 and older. However, it should be noted that in some cases, adults in their 50s may also fall into this category because a valuable research study has included them as part of the older adult participant group (e.g., De Beni et al., 2003; Federmeier et al., 2003).

Although age-related changes can be evident in the various abilities discussed in this book, possessing these skills to an adequate degree factors heavily into older adults' overall health and well-being (Shadden & Toner, 1997; Worrall & Hickson, 2003). Older adults who are in generally good health tend to feel younger than their chronological age (Gana, Alaphilippe, & Bailly, 2004). Conversely, aging adults in poor health tend to feel quite the opposite (Logan, Ward, & Spitze, 1992; Nakamura, Moritani, & Kanetaka, 1989). The majority of changes noted in the book happen gradually (Buckner, Head, & Lustig, 2006), differing significantly from the rapid neurological changes of early childhood. Although there are reports stating that physical and mental abilities peak in the 20s (Hutchinson, 2008; Skirbekk, 2003), plenty in the literature details the rewards of aging, such as mastering professional skills and hobbies (Abraham & Hansson, 1995; Ericsson & Kintsch, 1995), growing confidence (MacKinlay, 2006), and enjoying rich relationships with loved ones, friends, and colleagues (Adams & Blieszner, 1995). Thus, while the upcoming chapters often describe declines in abilities (Rabbitt & Anderson, 2006), these changes should not necessarily nor absolutely be viewed as losses. Yes, it is irritating to forget someone's name or to not be able to recall a piece of information as quickly as one wants, but such changes do not mean that older individuals have a poorer quality of life. Many would indeed argue otherwise.

Theoretical Perspectives

Many age-related cognitive theories have been developed and evaluated over the years. Despite the significant amount of literature available, no clear-cut theory has emerged to explain the underlying cognitive-linguistic changes that occur during aging. However, it may be impossible for one theory to account for the various changes that can affect so many different areas (Thornton & Light, 2006). Although this book rather tidily discusses specific abilities of older adults (e.g., auditory comprehension, writing), the reality is that these abilities often overlap. For example, intact attention and memory are needed so that individuals can comprehend questions asked of them and then formulate appropriate responses. Not only do abilities overlap, so can the theories presented, because they tend to encompass broad frameworks (Light, 1991; MacKay & James, 2001; Thornton & Light, 2006). Although these theories generally address underlying cognitive changes, such changes obviously will in turn affect comprehension and expression abilities. As Thornton and Light (2006) note, cognitive aging theories are generally applied in order to interpret normal age-related language changes. The rest of this chapter is meant to serve as a tutorial by presenting some of the most widely studied age-related cognitive theories. Although studies are discussed that support each of the theories, there are just as many investigations published that refute or question them. The following theories are presented: inhibition deficit, transmission deficit, cognitive slowing, and reduced resources, including reduced working memory abilities. A view that hypothesizes that neurobiological changes cause age-related cognitive declines is also discussed.

Inhibition Deficit

The inhibition deficit hypothesis posits that aging weakens inhibitory processes, making it more difficult for older adults to suppress irrelevant information compared with young adults (Hasher & Zacks, 1988; Zacks & Hasher, 1997). For example, older adults have greater difficulty ignoring a distracting word that is printed in a different typeface (Connelly, Hasher, & Zacks, 1991; Zacks & Hasher, 1997). Such distractions slow aging adults' reading and negatively impact their comprehension and memory of the text (Connelly et al., 1991; Zacks & Hasher, 1997). The presence of distracting speech can also adversely affect older adults' recall abilities. Tun, O'Kane, and Wingfield (2002) had younger and older adults listen to word lists presented in English while ignoring competing speech spoken in English (considered meaningful) or Dutch (considered meaningless). They found that older adults had greater difficulty compared with the younger adults in ignoring the competing speech and had poorer recall of the target words. They also

had the poorest performance when the competing speech was presented in English.

Other investigations on the inhibition deficit hypothesis involve word-retrieval or word-recognition tasks. To understand these studies, a few terms first need to be defined. *Neighborhood* refers to a group of words that differ from the target word by changing only one phoneme (Thornton & Light, 2006). An example of a neighborhood for the word *dog* would be *dig*, *bog*, *log*, and *dock*. The total number of neighbors that a target word has is referred to as *neighborhood density* (Thornton & Light, 2006). A word like *cat* resides in a high-density neighborhood because so many phonetically similar variations of the word can be obtained, such as *mat*, *that*, and *cab*, while a word like *wolf* resides in a low-density neighborhood because it has far fewer phonetically similar possibilities (J. D. Anderson, 2007). *Neighborhood frequency* indicates how often those neighbors are used (Thornton & Light, 2006).

Researchers have reported that older adults have greater difficulty than younger adults in identifying low-frequency words in high-density neighborhoods (Sommers, 1996; Sommers & Danielson, 1999). Examples of such words include *dot*, *pet*, and *cake* (Munson, 2007). However, context can help older adults perform generally as accurately as young adults, specifically when these words are used in highly constrained sentences (e.g., "The accident gave me a *scare*" versus "Ms. Smith considered the *scare*"). Sommers and Danielson (1999) theorized that aging adults' challenges with identifying low-frequency, high-density words shows their difficulty in inhibiting higher-frequency, phonologically similar words, leading to processing difficulties. In addition to neighborhood density, other investigators have reported that word length and word frequency can affect older adults' naming abilities (Spieler & Balota, 2000; Whiting et al., 2003). For example, older adults can have greater difficulty accessing the name of lower-frequency words (Spieler & Balota, 2000). Examples of low-frequency words are *brood* and *wool* (Whiting et al., 2003). Thus, the basis of the inhibition deficit hypothesis is that the inability to ignore the presence of distracting and/or competing information or thoughts makes it more difficult for older adults to accurately process and carry out various tasks.

Transmission Deficit

The transmission deficit account proposes that age-related cognitive changes occur because memory connections are weakened, leading to poorer activation of the target information (Burke, MacKay, Worthley, & Wade, 1991; James & Burke, 2000; MacKay & James, 2004). Semantic knowledge is organized into networks of nodes (i.e., concepts) connected via associated pathways (J. A. Anderson, 1983; Light, 1991). Findings from studies of tip-of-the-tongue experiences (TOTs) are often used to

support this theory. TOTs were first defined by Brown and McNeill (1966) in their seminal study as the inability to recall a known word at a time when "recall is felt imminent" (p. 325). Similarly, Schwartz (2002) more recently noted, "A TOT is a strong feeling that a target word, although currently unrecallable, is known and will be recalled" (p. 5).

TOTs increase with age and most frequently when recalling proper names and infrequently used words (Burke et al., 1991; Mortensen, Meyer, & Humphreys, 2006; Schwartz, 2002). It is believed that common names have more interconnections in memory and are more easily retrieved than proper names that are not as semantically interconnected and, therefore, have weaker connections (Thornton & Light, 2006). For example, James (2004) recently reported that older adults had more TOTs for a word when it was presented as a proper name (e.g., *Mr. Farmer*) versus when it was presented as an occupation (e.g., *farmer*), highlighting that semantic interconnections appeared to be stronger for common names than proper names. Maylor (1997) notes that the names of more common objects may also be easier for aging adults to retrieve because there may be more than one acceptable name for the item (e.g., *cup, mug*), whereas this is not usually the case for proper names. The concepts of neighborhood density and neighborhood frequency are also found in the literature regarding this particular theory. For example, older adults have more TOTs for words with low neighborhood frequencies, such as *lull*, *joke*, and *palm* (Vitevitch & Sommers, 2003). Such findings are interpreted to mean that words with high neighborhood frequencies have stronger memory interconnections, receive increased activation from their neighbors, and are more easily recalled (Thornton & Light, 2006).

Schwartz (2002) notes that when applying the transmission deficit theory to TOTs, it is assumed that a semantic level of representation and a phonological level of representation exist. For example, a person provided the definition "a device for protecting from rain or sun" (p. 52) may be able to evoke the meaning of the object and perhaps even visualize that object, but may not be able to access the phonological representation of the actual word *umbrella* (Schwartz, 2002). Low-frequency words (e.g., *kiosk, sump*) and words that have not been recently retrieved tend to lead to more TOTs than high-frequency words (e.g., *house, girl*) and words that have been accessed recently (Gollan & Silverberg, 2001; Schwartz, 2002).

Although aging weakens the link between semantic and phonological representations, leading to more TOTs in older adults (Mortensen et al., 2006; Rastle & Burke, 1996; Schwartz, 2002), the connections between these two levels improve with greater use (Schwartz, 2002). Hence, it would be reasonable to assume that strengthening such connections would reduce TOTs in aging adults. For example, White and Abrams (1999) and James and Burke (2000) found that when older

adults could not retrieve a target word when given a definition (e.g., "What word means to formally renounce a throne?" Answer: "Abdicate"), they resolved more TOTs when given a prime that shared some phonological component of one of the syllables of the target word (e.g., *ab*stract, in*di*gent, lo*cate*). White and Abrams (1999) reported that aging adults did best specifically when given a phonologically related prime for the first syllable (e.g., *ab*stract). Such improved performance indicates that the presentation of these additional words did not lead to difficulty suppressing irrelevant or competing information but instead demonstrated that with the appropriate assistance, weak connections were strengthened and ultimately led to improved retrieval (James & Burke, 2000; Thornton & Light, 2006).

Cognitive Slowing

Cognitive slowing has been theorized to be an underlying reason for age-related cognitive declines (Salthouse, 1996). Such slowing encompasses slower processing speed, reduced attentional abilities, and reduced working memory abilities. Although some believe that reduced attention and working memory can stand separately as theoretical underpinnings for cognitive changes in older adults (see next section), others view these reductions in a broader perspective (Salthouse, 1996). As Light (1991) notes, the relationship among these three components is complex and difficult to differentiate. Although no single reason for generalized slowing has been determined, it has been hypothesized to result from greater noise in the nervous system (Salthouse & Lichty, 1985), broken or reduced neural connections (Cerella, 1990), or an increased proportion in the loss of information at each step of processing (Salthouse, 1985).

Generalized slowing has been associated with older adults' challenges in language comprehension and recollection (Kemper, 2006). For example, aging adults have greater difficulty recalling speech segments that are presented at a faster rate but do well when speech segments are presented at a normal speaking rate (Wingfield, Tun, & Rosen, 1995). In studies in which individuals can control how fast speech segments are presented as well as the length of the segments they must listen to, older adults tend to choose slower speech rates and smaller segments (Wingfield & Ducharme, 1999; Wingfield, Lahar, & Stine, 1989). Slowing can also occur when reading. Older adults who demonstrate good recall of information spend more time reading an entire passage and syntactically complex sentences, whereas young adults spend more time reading infrequent words and new concepts presented for the first time in the text (Stine-Morrow, Loveless, & Soederberg, 1996). Investigations measuring the rate of rehearsal during memory tasks (Salthouse, 1990) and the rate of visual scanning on memory searches

(Cerella, 1985) report that aging adults have slower responses. Interestingly, Myerson, Hale, Wagstaff, Poon, and Smith (1990) point out that allowing older adults more time to complete a target task does not lead to improved performance.

Reduced Resources, Reduced Working Memory

The belief behind this theory is that older adults have fewer processing resources available to them than younger adults, causing age-linked deficits when these resources are exceeded (MacKay & James, 2001; Light, 1991). For example, listeners must rapidly identify and process individual speech sounds and words, then integrate other incoming words and sentences with what was previously spoken or stored (Pichora-Fuller et al., 1995; Thornton & Light, 2006). Auditory processing can become more effortful for aging adults if they have any degree of hearing loss, or if other variables are present, such as background noise or if more than one person is speaking simultaneously (Humes, 1996; Schneider, Daneman, Murphy, & Kwong-See, 2000; van Rooij & Plomp, 1990). In such cases, older adults must reallocate their cognitive resources and use other means to process incoming information, such as top-down processing. Top-down processing means that listeners have to rely on their own knowledge of the world and the context of the message to help them make sense out of what they are hearing. The challenge is that when aging adults become more dependent upon top-down processing, they have fewer resources available to focus on what the speaker is saying, possibly missing valuable information. In contrast, reading studies have shown that while older adults may read more slowly at the beginning of a passage, possibly to establish general comprehension of the text, they read more quickly as they proceed through the passage (Stine-Morrow, Gagne, Morrow, & DeWall, 2004; Stine-Morrow, Miller, & Leno, 2001), possibly freeing up cognitive resources to focus on new or unfamiliar information.

As previously noted, some authors do not separate reduced resources (e.g., attention) and reduced working memory from cognitive slowing (Salthouse, 1988a, 1988b). Others believe that a reduction in working memory is the reason for age-related cognitive difficulties (Caplan & Waters, 1999; Waters & Caplan, 1996, 2001, 2005). Working memory requires individuals to manipulate, store, and transform pieces of information (Baddeley, 2003), such as when mentally calculating the tip to leave at a restaurant. Older adults have declines in their working memory (Connor, 2001; Craik, 2000), and such declines have been hypothesized to occur as the result of less storage capacities (Zacks & Hasher, 1988), reduced efficiency in carrying out the needed operations (Stine & Wingfield, 1987), and mental slowing (Salthouse, 1990). Waters and Caplan (2001, 2005) further speculate that a general working memory

decline may be too broad to explain age-related language declines, and that more specific interpretations are needed (e.g., a theory addressing reduced working memory negatively affecting sentence comprehension).

Researchers have found that when working-memory tasks are sufficiently difficult, such as repeating complex sentences or completing backward digit-span tasks (i.e., repeating a string of numbers in reverse order), younger adults perform better than older individuals (Kemper, 1986; Light, 1991; Salthouse, Kausler, & Saults, 1988). Age-related changes in working memory can also lead to less grammatically and syntactically complex language (Kemper, Herman, & Lian, 2003; Kemper & Sumner, 2001). Kemper, Marquis, and Thompson (2001) elicited autobiographical narratives over the course of 7–17 years from adults who were ages 65–75 at the first assessment and ages 79–83 at the final assessment. Sample questions included "Describe the persons who most influenced your life" and "Describe an unexpected event that happened to you." Measures were taken on propositional density and grammatical complexity. Propositional density refers to how much information is conveyed relative to the number of words spoken (Kemper & Sumner, 2001). The most significant declines in grammatical complexity and propositional density (i.e., individuals use more words to convey a message) occurred between the ages of 74 and 78 with more gradual declines before and after that interval. However, there was considerable individual variation in older adults' initial levels of grammatical complexity and propositional density as well as in their levels of decline. In addition, older adults' discourse is often rated as more interesting and informative than that of younger adults (James, Burke, Austin, & Hulme, 1998). Aging adults are also able to modify their speech when talking to children and persons with cognitive impairments (Adams, Smith, Pasupathi, & Vitolo, 2002; Kemper, Anagnopoulos, Lyons, & Heberlein, 1994), suggesting that their working memory abilities are adequate for keeping in mind the content of what they want to say while they alter their speech to accommodate listeners' comprehension levels.

Neurobiological Changes

Proponents of this theory report that neurobiological changes are at the root of normal age-related cognitive declines, and this pattern of decline in healthy aging adults (e.g., difficulties in attention, working memory, executive functions) is quite similar to the neuropsychological profile of persons who have damage to the prefrontal cortex (Braver et al., 2001; Moscovitch & Wincour, 1995; Perfect, 1997; Salat, Kaye, & Janowsky, 1999; West, 1996). It is well documented that older adults exhibit a reduction in brain volume and ventricular enlargement compared with younger adults (Buckner et al., 2006; Davis & Wright, 1977). Although brain volume reduction generally begins appearing after the

age of 60, the area affected the earliest and to the largest degree is in the frontal cortex (Haug & Eggers, 1991; Salat et al., 1999). For example, healthy older adults do not completely activate areas in the frontal cortex to the same level that young adults do (Logan, Sanders, Snyder, Morris, & Buckner, 2002; Nyberg et al., 2003) when memorizing faces (Grady et al., 1995) or purposefully committing information to memory (Buckner, Kelley, & Petersen, 1999; Fletcher & Henson, 2001).

These cognitive declines in older adults are also thought to be associated with age-related reductions in the dopamine neurochemical system (Arnsten, Cai, Steere, & Goldman-Rakic, 1995; Li & Lindenberger, 1999; Li, Lindenberger, & Frensch, 2000; Li, Lindenberger, & Sikstrom, 2001), which Braver and colleagues (2001) believe regulates the prefrontal cortex. Based on studies that report dopamine reductions in aging, it would be reasonable to assume that increasing the level of dopamine through the use of pharmacological agents (e.g., Levodopa) would possibly stop or reverse such cognitive declines. In reality, aging adults have fewer dopamine receptors in the prefrontal cortex (Suhara et al., 1991), which might not allow such medications to work fully (Braver et al., 2001). Others report that age-related cognitive declines result from deficits involving not only the frontal cortex and basal ganglia, but also the hippocampus and associated structures in the medial temporal lobe (Buckner et al., 2006).

Conclusion

In conclusion, the aging process can affect a multitude of abilities assessed by SLPs. Although the literature reports a great deal of information on these abilities in older adults, defining *healthy* and *older* can be somewhat ambiguous. In addition, many theories have been hypothesized in order to account for age-related changes in cognition and language. As of yet, however, no single theory has emerged to explain the multitude of changes that aging adults demonstrate. Despite the declines that are reported in the upcoming chapters, many older adults enjoy vital and fulfilling lives.

Quick Facts

- General Information:
  - SLPs need to know what is considered normal for older adults' cognitive-linguistic, motor speech, voice, and swallowing abilities
  - SLPs must learn to view the health of aging adults in a broader sense using the WHO's *International Classification of Functioning, Disability, and Health*

    - These needs coincide with the continuing quest for EBP in the field of speech-language pathology
- Operational Definitions for This Book:
    - *Healthy* refers to the lack of any kind of neurological disease or disorder (e.g., stroke, dementia) that would interfere with the abilities discussed in this book
    - The terms *normal* and *neurologically intact* may be used synonymously with the word *healthy*
    - In research studies, *aging* and *older* generally refer to individuals aged 65 and older, but some studies have included adults in their 50s
    - Possessing the abilities presented in the book to an adequate degree factors heavily into older adults' overall health and well-being
    - Older adults who are in good health feel younger than their chronological age, while those in poor health feel the opposite
    - Rewards of aging include mastering professional skills and hobbies, gaining confidence, and enjoying rich relationships with loved ones, friends, and colleagues
- Theoretical Perspectives:
    - No clear-cut theory has emerged to explain the underlying causes of age-related cognitive-linguistic changes
    - It may be impossible for one theory to account for the various changes
    - Age-related cognitive theories can overlap
    - Inhibition Deficit:
        - Aging weakens inhibitory processes, making it more difficult for older adults to suppress irrelevant information
    - Transmission Deficit:
        - Age-related cognitive changes occur because memory connections are weakened, leading to poorer activation of the target information
    - Cognitive Slowing:
        - Encompasses slower processing speed, reduced attentional abilities, and reduced working memory abilities
    - Reduced Resources, Reduced Working Memory:
        - Older adults have fewer processing resources available to them than younger adults do, causing deficits when these resources are exceeded
    - Neurobiological Changes:
        - Cognitive declines in normal aging result from reductions in prefrontal cortex function and dopamine

Discussion Questions

1. Why is chronological age typically reported when physical age takes one's overall health into consideration?
2. Does your definition of a "healthy" adult change if you know someone's chronological age? Why?
3. What are ways in which normal aging adults can strengthen memory connections?
4. Some benefits to aging are listed in the book. What are some other benefits to aging? Provide personal examples from your life.

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