Cognitive Communication Disorders

Third Edition

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Preface

Welcome to the third edition of *Cognitive Communication Disorders.* As I write this, it's hard to fathom that five years have gone by since the second edition was published and almost 10 years have elapsed since the inaugural release of the book in 2011. I'm grateful and appreciative that the text remains a valuable resource for instructors, students, and clinicians dealing with the diverse population of individuals with cognitive communication disorders.

There's a challenge in developing a third edition of a book. The goal is to find the right balance between maintaining the foundation that made it a resource in the first place and refreshing the content in a manner that ensures its ongoing relevancy to the reader. I believe the third edition has met the challenge in a number of ways.

First, I'm grateful to the authors who remain with the text (Margaret Blake, Fofi Constantinidou, Nidhi Mahendra, Carole Roth, and Sarah Wallace) and were again excited to revise and update their contributions from the second edition. I'm grateful to the new authors who have come on board for the third edition, some as coauthors, Jessica Brown (traumatic brain injury [TBI]) and Kathryn Hardin (mild TBI); Sarah Villard, who took on a complete revision of the chapter on attention; and Maya Henry and Heather Dial, who contributed a new chapter on primary progressive aphasia.

Second, readers familiar with the first and second editions will note some significant changes to this text as a direct result of user feedback solicited by the Plural Publishing team. These include the addition of a chapter on primary progressive aphasia and a major revision to the chapter on mild TBI to include sports-related concussive disorders. Also new to the third edition is the inclusion of a case study in each chapter to demonstrate the clinical applications of the information presented by their respective author(s).

Finally, all the contributors have refreshed and updated their material with the latest evidence-based research. The rapid pace of advances in our understanding of the cognitive foundations of communication and advances in clinical management of individuals who have cognitive communication disorders are reflected in the updated content in each chapter.

The book remains organized in the same fashion as the previous two editions. The first three chapters (attention by Dr. Sarah Villard, memory by Dr. Fofi Constantinodou, and executive function by Dr. Mary Purdy) provide the foundational understanding of the cognitive systems that support communication. Each of these distinguished

authors provides information on the current state of knowledge regarding their respective cognitive domain and go on to address issues related to clinical management of disorders specific to each.

The book then pivots to the juncture where cognition and communication meet in the clinical populations of associated with right hemisphere disorders (Chapter 4, Dr. Margaret Blake), primary progressive aphasia (Chapter 5, Drs. Maya Henry and Heather Dial), dementia (Chapter 6, Dr. Nidhi Mahendra), mild TBI/concussion (Chapter 7, Drs. Carole Roth and Kathryn Hardin), and traumatic brain injury (Drs. Brown, Wallace, and Kimbarow).

With gratitude to all the contributors to the third edition, I trust you will find this latest edition worthy to take its place next to the first two.

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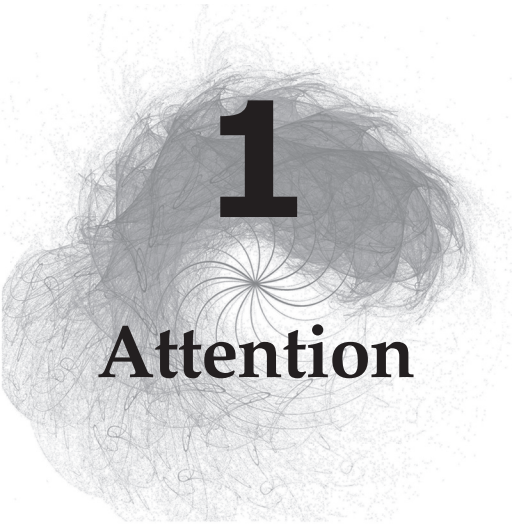

1 Attention

Sarah Villard

Introduction

Interest in the cognitive skill of attention within the field of speech-language pathology has increased considerably over the past two to three decades. Although attention is not specifically a language skill, it is an essential cognitive process that may interact with language and communication in several different ways. Impairments in attention have been observed in individuals with a number of different neurologically acquired and degenerative conditions, including stroke, traumatic brain injury, and various types of dementia. Even in aphasia, traditionally conceptualized as a language-specific impairment, attention deficits have frequently been noted and are becoming increasingly of interest. Researchers in communication sciences and disorders are continuing to refine the ways in which principles of attention can be applied to better understand neurogenic impairments, and clinicians who assess and treat cognitive communication disorders now routinely consider attention alongside other cognitive-linguistic abilities.

The aim of this chapter is to discuss the construct of attention as it relates to clinical practice in speech-language pathology. In order to properly contextualize this discussion within the historical literature on attention, we will start with an overview of some basic principles of attention, as well as several major historical models and theories of attention from the neuropsychological literature on healthy populations. The discussion will then shift to the ways in which attention manifests in specific acquired and degenerative cognitive communication disorders, as well as the ways in which existing models of attention may be able to enhance our understanding of these disorders. Next, principles of assessment and treatment of attention within the field of speech-language pathology will be outlined, and some specific assessment tools will be described. Finally, a case study will be presented as an example of how these principles and tools might

be applied to better understand the role of attention in the assessment and treatment of an individual patient.

Central Principles of Attention

A major challenge in studying the cognitive skill of attention is defining precisely what attention is. Most of us have a general sense of what it entails —after all, "attention" is a familiar term that occurs frequently and flexibly in everyday conversation. We may casually comment that an individual has a short or long "attention span"; we may remind someone that important information is forthcoming ("Pay attention!"); we may talk about "attention to detail" or about "drawing someone's attention" to something. We may associate the idea of attention with concepts such as distraction or multitasking or meditation, or with the feeling of suddenly realizing we have just read the same paragraph over several times without absorbing any of its content. And particularly in recent years, with the ever-increasing ubiquity of scrolling, texting, news feeds, and social media, many of us report an increasing sense of concern about whether our habit of scanning and flitting from image to image and from page to page could be negatively impacting our ability to focus on a single topic for longer periods of time.

These everyday references to attention, however, are sprawling and imprecise, and it is difficult to extract from them a definitive definition of this construct. Is attention one thing or many things? Is it about how *long* we can pay attention? Is it about how *well* we can pay attention? Or is it more about how many things we (think we) can pay attention to at the same time? How can we measure an individual's attention, and what does that mean? And—most importantly for our discussion here—how does attention fit into the assessment and treatment of cognitive communication disorders?

The first step in considering how attention may manifest in clinical populations will be to consider the ways in which the neuropsychological literature has defined attention in healthy people. This is no small undertaking, as a variety of models and theories of attention have been proposed over the past seven or so decades, and each one characterizes attention somewhat differently. We will consider a number of major historical models of attention in this chapter. However, before delving into specifics, it may be useful to first outline several broad, fairly universal principles of attention that are inherent in multiple models.

The first central principle of attention is that it is always defined in relation to a stimulus: You always pay attention *to* something. A stimulus can be either external (originating from the environment) or internal (originating from within the individual). Examples of external stimuli could include a funny story your sister tells you about her dog, the rapidly falling shapes in a game of Tetris, the lyrics of "Bohemian Rhapsody," or this chapter you're currently reading. Some examples of internal stimuli are a mental grocery list, a major decision you're trying to think through, or a childhood memory. In some cases, you might also be attending (or attempting to attend) to multiple stimuli at once. For example, you might be writing an email while also watching

a talk show and dividing or switching your attention between the two. The important takeaway here, however, is that in order for attention to take place, at least one stimulus must be involved.

A second, related principle of attention that relates primarily to external stimuli is that the modality of the stimulus should always be identified and noted. We can attend, for example, to an auditory stimulus such as a radio news program or an intercom announcement; likewise, we can also attend to a visual stimulus such as a silent film or a chess game. Many of the objects we attend to on a daily basis consist of a combination of auditory and visual stimuli; an action film, a live dance performance, a thunderstorm, and a family member speaking to us from across the dinner table all fall into this category. Additionally, although it is common to think of attention in terms of the visual, auditory, or combined visual-auditory modalities, it is certainly also possible to attend through other modalities—reading Braille, for example, requires attention through the tactile modality. We may also attend to simple everyday stimuli such as the wind on our face (another tactile stimulus), to the smell of something baking in the next room (an olfactory stimulus), or to the taste of an apple (a gustatory stimulus).

Another notable feature of attention is that it is thought to be closely connected to other processes such as memory and executive function, as well as to the effective use of language to communicate. From a certain perspective, you might even say that attention functions as a prerequisite that must be fulfilled before certain other cognitive-linguistic operations can be successfully carried out. For example, how could you possibly recall a set of verbal directions if you were not able to pay attention to the directions when they were originally given? How could you harness executive function to create and execute a plan without directing some attention toward that plan? How could effective communication occur without attention to the topic or attention to a communication partner's message? Attention is necessary for all of these cognitive-linguistic activities. This interconnectedness of attention with other cognitive-linguistic skills can present a challenge in studying attention in an experimental or evaluation context, as it can be difficult to cleanly separate from other processes. This issue will be further explored later on when discussing the assessment of attention.

This brings us to perhaps the two most important features of attention as it is understood in the neuropsychological literature: *capacity limitation* and *selection*, concepts that are closely related to one another and should be considered in tandem. The first, capacity limitation, refers to the fact that the human attention system can only process a limited number or amount of stimuli at once. The second, selection, represents the ability of this system to focus on stimuli that are most relevant to its behavior, goals, or interests, while ignoring or filtering out stimuli that are less relevant. We could consider capacity limitation to be a weak point of the human attention system and selection to be a complementary strong point: We may not be able to attend to everything at once, but at least we can be somewhat selective about which stimuli we *do* want to attend to.

The psychologist William James, who wrote about attention in the late

19th century, summed up the ideas of capacity limitation and selection nicely in the following passage:

> [Attention] is taking possession by the mind, in clear and vivid form, of one out of what seem several simultaneously possible objects or trains of thought. Focalization, concentration, of consciousness are of its essence. It implies withdrawal from some things in order to deal effectively with others and is a condition which has a real opposite in the confused, dazed, scatterbrained state which in French is called distraction. (James, 1890/1950, pp. 403–404)

While James's characterization is somewhat more philosophical than evidence based, it nicely expresses the idea that in many everyday situations, a multiplicity of different stimuli competes for our attention, and if we are to "deal effectively" with any of them, we must (consciously or subconsciously) select specific stimuli on which to focus our attention and find a way to ignore the others. As an illustration, think of all the many stimuli that might bombard you as you enter a busy restaurant: the sights of tables, chairs, lights, menus, the décor, the hostess, servers, and other patrons, as well as the sounds of clinking glasses and silverware, the music, and the numerous conversations unfolding simultaneously around you. Due to capacity limitations, it would be difficult if not impossible to attend fully to all of these stimuli at once. Even in a calmer, less complicated situation (e.g., if you were sitting alone on the couch reading a book), capacity limitations would likely still be at play. In this case, the multiple stimuli competing for your attention might consist of the words on the page, the feel of the book in your hand, the light in the room, the ticking clock, your occasionally vibrating phone, and the distant hum of a lawnmower or of cars going by outside, as well as perhaps internal stimuli such as thoughts about dinner or about a conversation you had earlier in the day.

Typically, selection is based on which stimulus or stimuli are most relevant to the task or behavior we are currently engaged in. In the above example in which your chosen task is reading, presumably with the goal to finish the chapter, the book is the relevant stimulus and most other stimuli in your environment are irrelevant by comparison. In the restaurant example, the most relevant stimulus might be the hostess as she asks how many are in your party. Ideally, you would want to select and attend to these relevant stimuli, while ignoring or filtering out stimuli that are less relevant.

Theories and Models of Attention

Having outlined some fundamental principles of attention, we will now discuss several of the most influential theories and models of attention that have emerged in the neuropsychological literature since this cognitive skill began to be studied systematically and in depth, in the mid-20th century. In general, models of attention tend to fall into one of three categories: models that attempt to explain selection, models that focus on capacity limitations, and models that delineate different subtypes of attention. Major examples of each of these three types of models will

be discussed in turn. Where relevant, important experimental findings will also be described.

Theories and Models of Selection

Much of the literature on attentional selection has been influenced by early investigations of the "cocktail party problem" in the 1940s and 1950s. The "cocktail party problem," a term originally coined by Colin Cherry (1953), refers to the challenge of selectively attending to a target speech stream when other, less relevant, auditory information is also present. As the term suggests, this phenomenon is exemplified by the experience of engaging in conversation with a friend at a noisy cocktail party, surrounded by a bevy of other conversations, and trying to selectively attend to what that friend is saying while filtering out all the other audible talkers (for a recent review of the cocktail party problem, see Bronkhorst, 2015). Early work on the cocktail party problem sought to identify factors that make this type of selective listening more—or less—successful. An early experiment by Cherry (1953) included a dichotic listening task, in which two different speech streams were presented to a listener simultaneously, one in each ear via headphones. The listener was asked to attend to the ongoing message in one ear, repeating it aloud as it was heard (a task known as "shadowing"). It was found that when listeners were asked to shadow the message in one ear but were later asked about the voice and message played into the other, unattended ear, they were typically unable to report anything about that unattended message other than global acoustic information about the speaker (e.g., whether they had perceived a male or female voice). This is a clear example of selection, in which the listener selected one message to process, at the expense of the other.

A subsequent experiment by Broadbent (1952) added to this work, expanding the understanding of the role of attention in selective listening. In this experiment, subjects listened to two messages spoken by two different voices, but instead of the two messages being played simultaneously and funneled to different ears (as in the dichotic listening experiment above), the messages were serially interleaved, word-by-word. The subject heard the first word of the first message, followed by the first word of the second message, followed by the second word of the first message, followed by the second word of the second message, and so on. The subject was instructed at the start to listen and respond to only *one* of these two messages. Results suggested that presenting sentences in this way caused confusion for the subject or, as Broadbent termed it, "failures of attention in selective listening."

The finding that interleaved, non-overlapping speech could negatively impact processing of a target message was critical because previous work on selective listening had mostly asked listeners to attend to target speech in the presence of sustained, overlapping background noise (e.g., Egan & Wiener, 1946). In these experiments, difficulty understanding the target was usually attributed to time-frequency overlap between the target and the masker (i.e., the irrelevant or distractor stimulus).

Because the auditory system processes sounds in time-frequency units, any time-frequency unit containing strong energy originating from the masker could result in a reduced ability of the listener to detect energy in that same unit originating from the target. This would not be considered a failure of the listener's attention abilities but rather a physiologically based inability of the listener's peripheral auditory system to detect target energy. Broadbent's (1952) experiment, however, demonstrated that even in a paradigm with zero time-frequency overlap between target and masker, confusion could still occur. The existence of masking effects that cannot be explained by time-frequency overlap between target and masker has been confirmed by a number of more recent studies using more technologically advanced methods (e.g., Arbogast, Mason, & Kidd, 2002; Brungart, Chang, Simpson, & Wang, 2006). This additional level of masking, now known as "informational masking," is thought to be due to higher order, central processing factors including attention (for a review, see Kidd & Colburn, 2017). Researchers have also identified a number of factors that influence the extent to which listeners are able to selectively attend to target speech, including degree of spatial separation between target and masker (e.g., Freyman, Balakrishnan, & Helfer, 2001), degree of linguistic similarity of the target and masker (Brouwer, Van Engen, Calandruccio, & Bradlow, 2012), and familiarity of the target and masker languages (e.g., Van Engen & Bradlow, 2007). Such findings are highly relevant to attentional selection in everyday situations, particularly in relation to auditory stimuli.

Early work on auditory selective attention also produced three notable theories about the process whereby the human attention system may select relevant stimuli and filter out irrelevant stimuli. These theories are known as the *early filter theory*, the *filter attenuation model*, and the *late filter model*. These models were all designed to explain the steps involved in attentional selection; however, they differ from one another in the specifics of those steps. The *early filter theory* (Broadbent, 1958) suggests that all stimuli receive preliminary analysis of general features such as location or intensity but that irrelevant or unattended stimuli are filtered out at a relatively early stage of processing, while the attended stimulus is selected and goes on to receive additional processing. The *filter attenuation model* (Treisman, 1960) was developed later, based in part on results that called the early filter theory into question. Specifically, it was found that even though subjects in dichotic listening tasks were usually unable to report any content from the unattended ear, they were sometimes able to report part of this content if it was highly salient (Moray, 1959; Treisman, 1960). Like the early filter model, the filter attenuation model posits that relevant stimuli are selected early on for further processing; however, in the filter attenuation model, unselected stimuli are not completely filtered out but rather are attenuated, making them potentially available for further analysis later on. Finally, the *late filter* (or *late selection*) model (Deutsch & Deutsch, 1963) theorized that all stimuli are analyzed in the early stages of processing and that selection of the target stimulus occurs later and is based on "importance weighting." Although all three models

have influenced the study of attention, a number of more recent studies have lent support to Treisman's filter attenuation model (e.g., Cowan, 1997; Driver, 2001). A fourth, more recent model has suggested that the extent to which irrelevant stimuli are ignored may depend on the perceptual load and cognitive control load of the relevant information (Lavie, 1995; Lavie, Hirst, de Fockert, & Viding, 2004). This model offers a possible compromise between the earlier models of selection.

In addition to the theories described above, which are all based on work in auditory attention, several influential theories of selection have developed from work on visual attention. One of these is the spotlight theory of attention (Posner, Snyder, & Davidson, 1980), which suggests that visual cues can trigger the formation of a "spotlight" in a specific location of the visual field, and as a result, an object in that location receives enhanced processing. It has been argued that the idea of attention as a spotlight may have limitations in dynamic visual scenes (i.e., those involving object movement) (Driver & Baylis, 1989); however, the basic analogy of attention as a mechanism that highlights a specific visual object in a potentially complex scene is still highly intuitive and useful. Although the idea of a "spotlight" lends itself most easily to visual attention, it can also be applied to auditory attention (Fritz, Elhilali, David, & Shamma, 2007).

A related theoretical principle of visual attention is that of object formation. Object formation is the concept that humans, when presented with a complex mixture of sensory information (sometimes known as a visual or auditory "scene"), tend to perceptually group the sensory information in this scene into specific "objects" (Desimone & Duncan, 1995). This grouping is typically based on perceived spatial location, as well as on other qualities (e.g., color and contour in the visual modality). To give a simple visual example, if you see a blue circle on your left, a green square on your right, and a yellow circle straight ahead, you will almost certainly, and without thinking much about it, perceive these areas of color as 3 separate objects (rather than as 2 objects or 11 objects or as simply a cluttered mess) and will attend to them as such. Shinn-Cunningham (2008) extended the theory of object formation to apply to auditory attention as well, defining an auditory object as "a perceptual entity that, correctly or not, is perceived as coming from one physical source" (p. 2). If you hear a bark that you perceive to be coming from your left, a meow that sounds like it's coming from your right, and a chirp straight ahead, then your brain will use this information to form three auditory objects originating from three different animals. Object formation, whether visual or auditory, is relevant to attentional selection: The attention system may be considered to be selecting between competing perceptual objects.

Theories and Models of Capacity Limitation

Another group of theories of attention has focused not on selection per se but rather on the limits of attentional capacity. Attentional capacity has frequently been considered and studied in the context of dual-task experiments, in which