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Lisa Tabor Connor

*Boston University*

Martin L. Albert

*Boston University*

Nancy Helm-Estabrooks

*Boston University*

Loraine Obler

*CUNY Graduate Center*

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## Attentional Modulation of Language Performance

Lisa Tabor Connor and Martin L. Albert

*Harold Goodglass Aphasia Research Center, Department of Neurology, Boston University School of Medicine and Research Service of the Department of Veterans Affairs Medical Center, Boston; and Language in the Aging Brain Laboratory, Boston University School of Medicine*

Nancy Helm-Estabrooks

*Harold Goodglass Aphasia Research Center, Department of Neurology, Boston University School of Medicine and Research Service of the Department of Veterans Affairs Medical Center, Boston; and National Center for Neurogenic Communication Disorders, University of Arizona*

and

Lorraine K. Obler

*Harold Goodglass Aphasia Research Center, Department of Neurology, Boston University School of Medicine and Research Service of the Department of Veterans Affairs Medical Center, Boston; Language in the Aging Brain Laboratory, Boston University School of Medicine; and CUNY Graduate Center, Program in Speech and Hearing Sciences*

During the last quarter of this century, neuroscientists have gained in-depth knowledge of the operations of individual cognitive abilities—language, memory, and attention. It is now time for neurolinguists to integrate these cognitive functions to produce a cognitive neuroscience of language as a whole, addressing the dynamic interplay among cognitive abilities. Toward that goal, inroads have been made recently in investigating the interaction between memory and attention in working memory for language (e.g., Carpenter, Miyake, & Just, 1994; D’Esposito, Detre, Alsop, Shin, Atlas, & Grossman, 1995; Waters & Caplan, 1996a, 1996b). There has been increasing momentum in exploring the extent to which other aspects of cognition

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Address correspondence and reprint requests to Lisa Tabor Connor, Ph.D., VA Medical Center (12A), 150 S. Huntington Avenue, Boston, MA 02130. E-mail: [lconnor@bu.edu](mailto:lconnor@bu.edu).



may influence or account for the performance deficits seen in aphasia. Our research group has been focusing on the interaction of attentional processes and auditory comprehension in aphasic individuals. We use the example of attentional modulation of comprehension to argue for the importance of interplay between language and attention.

Aphasiologists, to a great extent, have been invested in the concept of aphasia as a purely linguistic deficit in order to build and test models of language processing and its instantiation in the brain. Moreover, the characterization of aphasia as a linguistic deficit has profoundly influenced aphasia therapy methods. The field of clinical aphasiology has developed under the central assumption that dysfunction of language is the principal cognitive deficit in aphasia and should be the primary target of rehabilitation. Only recently (Helm-Estabrooks, 1998; Holland, 1994) has this central assumption been called into question. Although cognitive approaches to rehabilitation have been proposed (e.g., Seron & Deloche, 1989; Schwartz, Saffran, Fink, Myers, et al., 1994), they have largely emphasized detailed cognitive descriptions of the language deficit, rather than the interaction of the various cognitive abilities.

There are several studies in the literature that highlight the importance of attentional processing in the language deficits exhibited in aphasia. Three lines of evidence converge on the crucial role of attentional deficiencies in aphasia that produce auditory comprehension deficits. First, individuals with aphasia exhibit substantial variability in performance on tasks of auditory comprehension (McNeil, 1983), a result borne out in work in our laboratory. Our detailed examination of patients' performance on multiple pretreatment assessments has revealed substantial retest inconsistency at the level of individual items, despite stability in overall auditory comprehension scores. We believe that this variability in performance implicates fluctuating access to intact language representations due to attentional fluctuation. A second line of evidence comes from studies investigating the role of interfering auditory information in both linguistic and nonlinguistic judgments in aphasic persons. In these studies (Erickson, Goldinger, & LaPointe, 1996; LaPointe & Erickson, 1991; Murray, Holland, & Beeson, 1997a, 1997b), linguistic and nonlinguistic judgments were compromised when competing auditory stimuli were present, even though it was not necessary for them to be attended to. A third line of evidence is that extra-linguistic stimulation can enhance the performance of aphasic individuals on tasks of auditory comprehension. Slowing the rate of input (Albert & Bear, 1974; Blumstein, Katz, Goodglass, Shrier, & Dworetzky, 1985; Campbell & McNeil, 1985), providing emphatic stress (Kimelman & McNeil, 1987; Slansky & McNeil, 1997), or providing an alerting signal (Loverso & Prescott, 1981) all serve to improve auditory comprehension.

If we acknowledge that disruptions of the attentional system affect auditory comprehension, what next? We believe that the pertinent questions to

be answered in the next century are: To what degree are attentional abilities compromised in persons with aphasia? What are the characteristics of the attentional deficits? Are they general or language-specific? Can these attentional dysfunctions be rehabilitated? How? What is the extent of the remaining language deficit in auditory comprehension? We believe that seeking the answers to these questions will have a significant impact on the development of the cognitive neuroscience of language and the opportunity to maximize functional communication in individuals with aphasia. The difficulties that lie ahead are in developing an adequate description of attentional deficits of each person with aphasia, in determining the degree to which distributed systems of attention are affected by brain lesions, and in capturing the dynamics of attention/language interaction both in moment-to-moment language processing and throughout the time-course of recovery from aphasia.

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