A Dissociation Between Auditory Comprehension and Sentence Completion: Theoretical and Clinical Implications

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Several investigators (Barton et al., 1969; Podraza and Darley, 1977; Pease and Goodglass, 1978) have documented the effectiveness of sentence completion cues for facilitating word production by aphasic patients. However, there are descriptions of patients in the literature which raise questions about the neurolinguistic processes required for sentence completion. In particular, questions arise as to whether or not sentence completion requires volitional access to lexical semantic representations or if target words can be produced based on a subvolitional level of lexical access.

Stengel (1964) described a patient, a "case of so-called transcortical aphasia with echolalia" (p. 286), who despite poor auditory comprehension completed sentences such as "How did you sleep last ..." (night) and "You are a good ..." (woman). Geschwind et al. (1968) described a 22-year-old woman who, following an episode of carbon monoxide poisoning, was echolalic and occasionally completed familiar phrases, proverbs and song titles. These authors suggested that auditory stimuli consisting of the first part of a familiar phrase might evoke the second part of the phrase, even though no other associations were evoked. Whitaker (1976) described a 59-year-old woman with presenile dementia related to marked frontal and temporal lobe atrophy. This patient's PICA overall score was 5.56 (8th percentile). She presented a severe auditory comprehension deficit. However, she demonstrated relatively intact sentence repetition and frequently corrected syntactically and phonologically incorrect sentences when repeating them. She repeated semantically anomalous sentences without modification. Of interest to the present study is this patient's completion abilities. She frequently completed sentences, proverbs and song titles accurately. A nonterminal intonation contour was required for successful completion. Whitaker hypothesized that the subject's completion of simple, high frequency or stereotyped phrases was attributable to a filtering function of the automatic aspects of grammar.

The purpose of this paper is to describe another patient who displayed the completion phenomenon in the presence of severe auditory comprehension and expressive language deficits. Moreover, unlike previously described patients, the subject of this paper also presented a severe repetition deficit.

METHOD

Subject. The subject of this investigation was a 66-year-old male. He was a college graduate and president of an international organization. Prior to December 22, 1984, he had no history of neurological insult or impairment, and he had no history of any previous speech or language impairment. On December 22 his car was struck from behind while he was driving to work. Over the next two days he experienced increasingly severe headache, exacerbating speech difficulty, and incoordination of the right hand. A CT scan administered on admission to a hospital on December 24, 1984 revealed a subdural hematoma over the left frontal, temporal and parietal lobes and an intraparenchymal hematoma in the mid convexity of the left frontal lobe.

Generalized cerebral atrophy was also observed. The subject's condition improved over the next three weeks, and he was discharged on January 19, 1985, with reportedly normal speech and language.

The subject was readmitted to the hospital on February 19, 1985. On this occasion, he presented with severe speech and language difficulty and right-sided weakness. A CT scan performed on February 20, 1985 revealed enlarged ventricles with prominent sulci and a low density region in the left frontal lobe. A scan performed on February 27, 1985 revealed large infarcts in the distributions of the left anterior and middle cerebral arteries. The subject was discharged from the hospital approximately three weeks later. He began intensive physical, occupational, and speech-language therapy in his home in May, 1985.

On initial evaluation, the subject presented profound speech and language impairments. His performance failed to surpass chance levels on any auditory, visual or gestural comprehension task. He was unable to repeat any words or phrases, and his spontaneous speech was limited to phonemic jargon. Recovery of speech and language abilities was very limited. The subject came to acknowledge greetings and would on occasion respond to questions with a stereotypic or jargon response. Spontaneous verbal output was limited to a few stereotypic words (e.g., "correspondence," "grace") and phonemic jargon. He was able to imitate familiar words and phrases with combined auditory and visual stimulation, but he was not echolalic. He employed facial expressions and gestures to convey emotions and for a few common requests (e.g., "more," "coffee," "bathroom").

Procedures. During speech and language therapy, it was observed that in spite of his severe auditory comprehension deficit, the subject frequently completed associatively loaded sentences. To test the apparent dissociation between auditory comprehension and sentence completion, a set of tasks using 20 common nouns was developed. The tasks included auditory recognition (with a response field of three unrelated pictures), sentence completion, and pointing to which of three unrelated pictures matched a word the subject had just produced in response to a sentence completion prompt. The 20 words and sentence completions are given in Appendix A. These stimuli were chosen for their high degree of association. They represent three types of associative relationships: 1) frequently occurring modifier + noun combinations (e.g., king-sized bed, black coffee, cold water); 2) combinations where the last word of the sentence completion and the target word might be considered a single lexical unit (e.g., school bus, wrist watch); and 3) frequently occurring phrases (e.g., go to the bathroom; strike a match).

These tasks were administered weekly for 8 consecutive weeks. On all occasions the subject was alert and cooperative. The results shown in Table 1 reveal that performance on the auditory recognition task never exceeded chance. Likewise, the subject's performance on pointing to which of three pictures matched a word he had just spoken in response to a sentence completion never exceeded chance. Sentence completions were presented with a nonterminal intonation contour, but with no exaggeration of suprasegmental features. On initial presentation of this task, the subject responded to 12 of the 20 stimuli with an immediate, well-articulated production of the target word. Thereafter, he responded accurately to at least 15 of the 20 stimuli. Error responses generally consisted of his stereotype "correspondence." On two occasions he substituted "orange" for "apple." A few perseverative responses (always "coffee") were also observed.

Table 1. Percent accurate responses on auditory recognition, sentence completion, and pointing to an appropriate picture following successful sentence completion for 8 weekly test administrations.

	Testing Session							
	1	2	3	4	5	6	7	8
Auditory Recognition	35	35	45	20	30	35	20	30
Sentence Completion	60	75	75	75	90	80	75	75
Pointing to Picture	33	27	33	20	17	44	33	27

The subject's performances were also assessed on a variety of other tasks using the 20 words given in Appendix A. The subject matched small to large pictures of the items with 100 percent accuracy. Gestural recognition and word-to-picture matching never exceeded chance. Repetition never exceeded 45 percent accuracy. Confrontation naming and reading aloud yielded stereotypic or jargon responses.

DISCUSSION

Over the eight-week period during which the subject's performance on a variety of language tasks using a common set of stimuli was assessed, his performance on completing associatively-loaded sentences was consistently and substantially better than on any other task. These data indicate a marked dissociation between the subject's auditory comprehension and his sentence completion. This dissociation can best be discussed in terms of the neurolinguistic processes involved in sentence completion. Figure 1 presents a model of these processes.

Following peripheral analysis of the auditory stimulus and central prelinguistic auditory processing, the sentence completion stimulus undergoes simultaneous phonological and prosodic decoding. The output of phonological decoding is then submitted to lexical and morphosyntactic decoding. Within the lexical decoding stage, the output of phonological decoding is matched to lexical phonological representations. Corresponding semantic representations are in turn accessed from the lexical phonological representations. The output of prosodic decoding is made available to morphosyntactic decoding and submitted to a decoding process by which affective information is extracted. Finally, the outputs of lexical and morphosyntactic decoding are used to derive the meaning of the stimulus. Moving to the response production side of the model, the completion word is retrieved from the lexicon and encoded phonologically. This is followed by the processes of motor programming and execution.

While it seems likely that individuals with adequate auditory comprehension comprehend a sentence completion stimulus prior to retrieving the completion word, the subject presented in this paper provides evidence that comprehension of the stimulus is not necessary for completion of

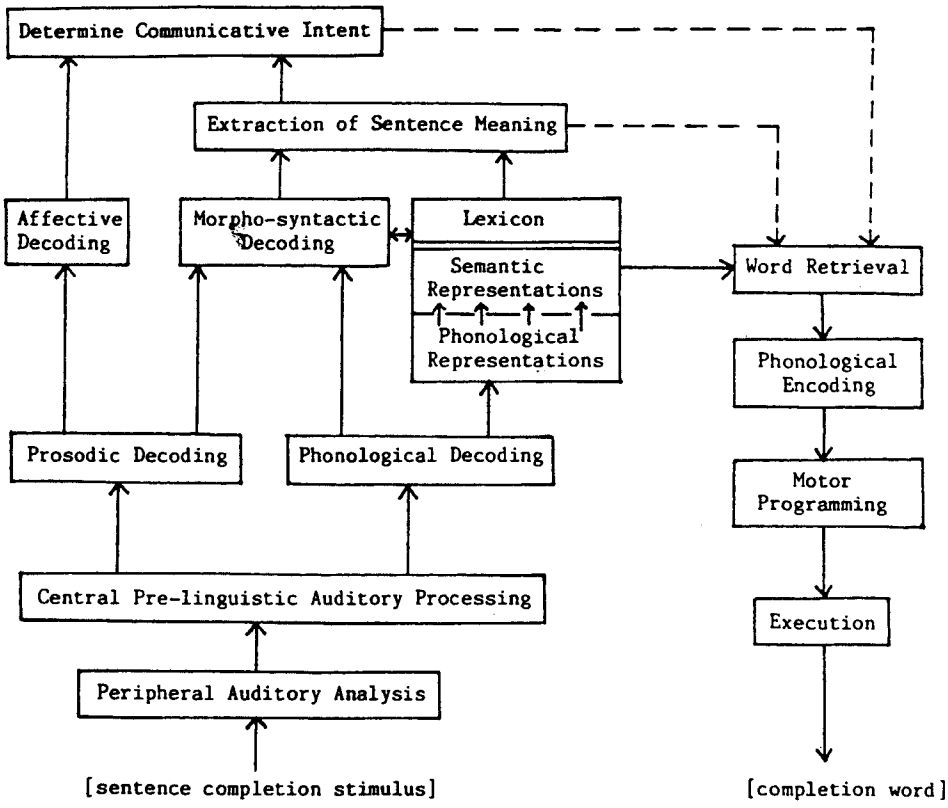

Figure 1. A neurolinguistic model of sentence completion.

associatively-loaded sentences. His ability to complete these sentences does, however, attest to the adequate, if not normal, processing of information to at least the level of matching the output of phonological decoding to appropriate lexical phonological representations. Moreover, lexical semantic representations appear to be activated to a level which permits retrieval of the target word for an essentially automatic vocal response, but not for the volitional use of the semantic information required by the auditory recognition task.

Support for this differentiation in levels of activation is found in the work of Milberg and Blumstein (1981, 1982). These investigators employed lexical decision tasks to investigate the semantic organization of aphasic subjects. They reported that their aphasic subjects responded with greater accuracy and shorter latency to words preceded by semantically-related primes than to ones preceded by unrelated or nonword primes. Thus semantic information in the lexicon appeared to be activated to some degree. This activation appeared to be limited, however, for when asked to judge the semantic relatedness of the same pairs of words used in the lexical decision task, the aphasic subjects experienced substantial difficulty. Furthermore, the subjects' performances on the semantic judgment task were significantly correlated with the severity of their auditory comprehension deficits, while their performances on the lexical decision task were not.

Milberg and Blumstein interpreted these results as being consistent with theories of lexical access which posit two distinct levels of word processing (Posner and Snyder, 1975; Neely, 1977). One involves an automatic activation of semantic information in the lexicon. The other involves volitional retrieval and manipulation of the semantic information for a specific lexical entry. Returning to the subject who provided the impetus for this discussion, one can speculate that the sentence completion stimuli activated semantic representations at the automatic level and that this level of activation was sufficient to permit retrieval of highly-associated completion words. However, sufficient activation at the volitional level failed to occur, and the subject was unable to perform any of the tasks requiring manipulation of the semantic information.

Prosodic information contained in the sentence completion stimulus may also have contributed to the subject's performance on this task. There is evidence to suggest that even those aphasic persons with severe auditory comprehension deficits are able to extract some information from the prosodic elements of a stimulus (Green and Boller, 1974). The nonterminal intonation contour of the stimuli may have both induced and facilitated the retrieval and production of the completion word.

In summary, the hypothesis is offered that the subject's completion of associately-loaded sentences was made possible by a combination of two factors. One is the activation of lexical semantic representations at an automatic, subvolitional level. The other is the predisposing and facilitating effects of the nonterminal intonation contour of the completion stimuli. Alternative explanations for this phenomenon include automatic activation at a phonological rather than a semantic level or that highly associated words and phrases are stored as units in reference memory and once activated are made available to the speech output mechanism. Neither of these hypotheses fit existing models of lexical access as well as the hypothesis being advanced, nor do they substantially alter the clinical implications to be drawn.

If, as hypothesized, sentences can be completed at an automatic level of lexical access, one may legitimately question the efficacy of sentence completion tasks in aphasia rehabilitation. For functional auditory comprehension and verbal expression, it is necessary that lexical semantic information be accessed in a way that permits volitional use of that information. Therefore, if sentence completion tasks are to be used in an effort to improve a patient's word retrieval, it seems important to verify that the semantic representations of the completion words are being activated at a volitional, as well as an automatic level. This can be accomplished by using a task such as that used in the current study in which having produced the completion word, the patient is asked to identify which of three or more pictures correspond to that word. Only when it can be demonstrated that the patient can use the semantic information can one assume with confidence that a lexical entry has been accessed at a level necessary for functional language use.

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APPENDIX A

Word	Sentence Completion
bed	You sleep in a king-sized ...
bus	Children ride on a school ...
watch	You tell time with a wrist ...
bathroom	I need to go to the ...
car	I wrecked my new ...
money	I spent all my hard-earned ...
light	Turn off the porch ...
soap	You wash your face with Ivory ...
hammer	You pound nails with a ...
coat	In winter you wear a fur ...
match	You strike a ...
coffee	I'd like a cup of black ...
eggs	I'd like some scrambled ...
bell	They rang the Liberty ...
knife	You cut string with a pocket ...
apple	I ate a juicy, red ...
house	You live in a ranch style ...
saw	You cut pipe with a hack ...
sandwich	I ordered a bacon, lettuce, and tomato ...
water	I'd like a glass of cold ...

Q: What did the subject do on repetition and what was the repetition task?
A: To do better than 45% accuracy he needed intense auditory and visual stimulation.

Q: How does that inability to repeat very well fit in with the model?
A: This patient would be classified as a global aphasic and in my opinion was severely apraxic. In a course of MIT, he could not progress beyond immediate imitation following integral stimulation. His repetition performance appeared to at least in part be related to a specific motor programming deficit.

Q: So not explained by the same problem?
A: No, I don't think it's explained by the same problem. The more relevant question may be how was the seemingly automatic processing at higher levels expediting the motor programming. That's one I'm still wrestling with.

Q: What was the auditory comprehension task?
A: Point to one of three unrelated pictures following "Point to the _____."

Q: I agree that you're probably getting an automatic response. I wonder what would happen if the auditory comprehension segment included longer stimuli. Maybe his auditory comprehension was worse for single words.
A: I tried a variety of auditory comprehension tasks including intoned phrases. His auditory comprehension was at chance levels across the board.

Q: I wonder if perhaps that arrow going from lexical phonological representations over to word retrieval might not have been one level lower. That is, if you look at some of the reading literature, you see a lot of people like Coltheart and Marshall suggesting that you can get an output word absolutely bypassing semantics. Related to that, could it be that your task was not accessing comprehension but phonological association? Did you try things like school, rather than "You ride on a school _____"? Could the phonological shape of the input word simply trigger the phonological shape of the target word?
A: I did not do that specifically, but I suspect, based on his performance on a variety of other tasks, including completion of less associatively loaded sentences which he could not complete, that such stimuli would have elicited no response or stereotypic utterances. That's one reason I've entertained the notion that such highly associative phrases can be processed almost independently of the language system. I agree that something analogous to nonlexical routes in reading might account for the subject's performance.

Q: I'd like to ask you to go beyond this case to the many other clinical experiences you've had and comment on the possible prognostic significance of a patient's ability to do sentence completion. Do you think that in the acute stage with a severe patient the ability to handle a sentence completion task is a good prognostic sign?
A: I'm encouraged whenever I see a linguistic stimulus produce some level

of activation in the lexicon. However, without some concurrent evidence of volitional use of language, I'd be extremely cautious.

Q: Have you seen other patients like this, and do you have some feeling of how they've done?

A: He's by far the most extreme. I've seen others, as I'm sure we all have, who do well on the first few levels of a task continuum and then hit a wall. They do well on fairly automatic tasks, but their overall recovery is poor. I think we have to be very careful about using automatic kinds of responses as prognostic indicators.

Q: Do you have any feelings about "hitting the wall" on the models you would use to talk about this condition? Does failure to move beyond say something about a model like the one you had on that slide?

A: If one constructs models of a variety of tasks incorporating a given process and approaching that process from different directions, one can verify impairment in that process or perhaps find ways of either facilitating the process or find a detour around the process.