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A Critical Look at the Notion of Selective Impairment

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The theoretical aphasiology literature is replete with claims that aphasic language behavior can result from selective damage to one or more modular functional subsystems of language (e.g., Caplan, 1993; Miceli & Caramazza, 1988). This theoretical claim is associated with clinical aphasiology in two ways: The support for the claim derives from the interpretation of clinical data, and the apparent cogency of the claim influences the ways in which practitioners conceptualize the nature of aphasia and implement assessment and treatment regimens (Byng, 1988; Mitchum & Berndt, 1991, 1992). Because of the influence of this perspective, it is important to examine its supportive evidence.

The concept of modularity as a principle of design of the cognitive system stipulates that various mental activities are organized into functional units that can operate independently of other such units (Coltheart, 1985; Fodor, 1983; Shallice, 1991). Superordinate mental domains, such as language, logical thinking, and calculation, are presumably able to operate independently of each other because the rules and procedures for executing each activity are specific to each module and because information necessary to the performance of one of these modules is not necessary for the operation of another module. The degree of penetration of this functional architecture into the organization of each cognitive domain, however, is a more controversial issue than is the notion that modularity characterizes the superordinate cognitive processing system.

Data from aphasic patients have constituted the springboard from which investigators have argued that modularity characterizes the language domain itself. Thus, the subcomponents of language (syntax, lexical-semantics, and phonology), as well as the modalities (particularly, comprehension and production), are argued to be controlled

by modules functionally separate from each other (Caplan, 1987; Caramazza & Miceli, 1991). Even constituent units of language subcomponents have been touted as functionally modular (Caplan & Hildebrandt, 1988; Caramazza & Miceli, 1991; Miceli & Caramazza, 1988). The idea, for instance, that syntax is an isolable subsystem, dissociated from other language subsystems, permits the conclusion that it may be damaged independently of other language modules. This potential relationship constitutes the strong version of the notion of selective impairment. Persuaded by evidence of selective impairment, many investigators have come to view the multifaceted language deficits in aphasic individuals as resulting not from a single underlying impairment, but from a concatenation of multiple, damaged, independent processing subsystems (Berndt, 1991; Caramazza & Miceli, 1991). For instance, a recent article in the literature reported evidence of a "pure dissociation between impairment in processing thematic roles and spared ability to process the morphological structure of sentences" (Caramazza & Miceli, 1991, p. 402). Similarly, Mitchum and Berndt (1991) interpreted some aphasic performance based on the "assumption that the communication symptoms that occur following focal brain damage represent functional impairments to isolable components of the normal language system" (p. 103).

Like any psychological construct, the notion of selective impairment can be elaborated in a strong or weak sense. Those not persuaded by the strong version, as described above, agree that language comprises modules of subcomponents but contend that these modules can and do partially interact during processing (Blumstein, 1987). This view allows the possibility of dissociations in performance but implies that disruption in one module necessarily influences other interlocking modules, albeit to potentially different degrees.

Studies examining selective impairment in aphasia are typically single-case investigations; the subject's performance is compared on two or more tasks representative of different aspects of language, such as word usage in oral expression and auditory comprehension, or oral production of inflectional and derivational morphemes. Differences in level of performance across the two tasks are accepted as evidence that each task is supported by a separate processing system (Caramazza, 1986); that is, if Task A is performed well and Task B is performed poorly, such a dissociation may signal that the module in control of one language process is intact or less damaged than the module controlling the other language process. The case for selective impairment of separate modules is presumably strengthened in those cases when a different patient demonstrates an opposite pattern of performance on the same tasks. This performance profile across subjects is called a double dissociation.

One method to assess the strength of dissociation claims is to determine if the experimental task designs meet standard criteria for research. In the past, several psychometric criteria for the acceptance of data as evidence for the claim of selective impairment were outlined (McNeil, Odell, & Tseng, 1991). This current paper will examine how successfully specific experimental data from a small set of published reports meet these criteria. These criteria are the foundation of principled basic research design. Achievement of these psychometric criteria are critical to assure that the results reported are real, that is, that they are reliable, valid, and significant. If the reported differences are not real in this sense, then one cannot meaningfully interpret the dissociations in performance. The following are important psychometric criteria that might be examined:

1. The experimental tasks are valid representations of the subsystem under consideration. Thus, the tasks must be supported by an analysis of content validity.
2. The data have been submitted to reliable inter- or intrajudge analysis. For tasks in which more than one answer or production can potentially be considered acceptable, such as in synonym or naming tasks, and in cases of error-type analysis, some measure of consistent rating of response is important.
3. The difference in performance levels across the two or more tasks is statistically significant.
4. The data represent consistent mean performance over time. Because variability in performance is a hallmark of aphasia, it is necessary to verify that the performance reported in the experimental results is representative of the subject's general performance. Test–retest data of levels and directional patterns of dissociated performance should demonstrate variations in mean performance levels that are not significantly different.
5. The data have been generated from tasks that are sufficiently sensitive to reveal subtle deficits and that are sufficiently difficult to permit error performance that is above chance levels.
6. The data have been generated from performance on tasks of equal difficulty. It is necessary to demonstrate that, for instance, relatively better performance on Task A and correspondingly poorer performance on Task B is not the result of Task A's being inherently easier than Task B. Proof of meeting this requirement can be supplied by normative data from aphasic, or less preferably, normal, individuals on the experimental tasks.

ANALYSIS OF DISSOCIATION CLAIMS

For the present study, the pertinent literature was scanned for reports that identified patients as aphasic and that made claims about dissociations and selective impairment in levels of language performance. In this paper, several studies are scrutinized for their success in meeting three of the psychometric criteria previously mentioned: test–retest reliability, equal task difficulty, and task sensitivity. Although not exhaustive, the analysis illustrates both how the literature may best be analyzed and the effect of doing so on the strength of the dissociation claims. The analysis is restricted in such a way that the degree of reaching each criterion is illustrated primarily by one study, although other studies demonstrate the same properties.

Criterion 1: Test–Retest Reliability

Costello and Warrington (1989) reported a case of an individual diagnosed with dynamic aphasia. The subject demonstrated two dissociations of interest: (1) his ability to produce a spoken sentence was superior when he was given a visual (picture) prompt in comparison to a verbal prompt, and (2) his ability to rearrange pictures into a sequential story was superior to his ability to rearrange words into a sentence. For instance, in the third experiment, the task was to produce a spoken sentence. In the verbal condition, either a single word or a whole sentence was given as a stimulus; in the picture condition, an action picture was the stimulus to produce a sentence. Performance levels were generally about 55% correct with either of the two verbal stimuli; with a picture stimulus, ability to produce a verbal sentence jumped to 94% correct. These performance differences between verbal and picture conditions, across four tasks, signaled to the authors that two separate planning systems exist: a verbal planning system and a visual planning system. However, test–retest reliability coefficients were not reported for any of the four experimental tasks in this study. This leaves the stability of these performance differences in question. Such a lack is especially problematic when the performance level is neither very low nor very high and the number of test items is relatively small, as in this study.

Criterion 2: Equal Task Difficulty

Nespoulous and colleagues (1988) demonstrated a dissociation between production and comprehension of syntactic elements. The production

tasks were varied, ranging from oral narration and single-word and sentence repetition to single-word and sentence oral reading. Comprehension was assessed with eight tasks, including the DeRenzi and Vignolo (1962) *Token Test*, passive and center embedded sentences, and tasks requiring the decoding of pronouns and articles. Typically, the subject exhibited errors in production of sentence-level grammatical morphemes, particularly pronouns. In contrast, comprehension of syntax was determined to be error-free.

However, the comprehension tasks may have been easier than production tasks for three reasons, resulting in better comprehension performance. First, the comprehension and production tasks themselves were different, and there was no objective rating of the difficulty of the two types of tasks; thus, the content of the comprehension tasks may have been inherently easier. Second, subjects may have performed better on the comprehension tasks because they were "off-line," that is, not demanding processing in real time, as did the production tasks (Tyler, Cobb, & Graham, 1992). This point was raised by the authors, to their credit. The third piece of evidence that comprehension may have been easier than production is that many of these comprehension tasks entailed response through a closed set of choices, unlike the open-endedness of production tasks. These methodological differences may prove crucial to their argument of intact versus impaired processing. Thus, these data do not definitively demonstrate impaired syntactic production and intact syntactic comprehension and, therefore, cannot be used to support a view of language processing in which production and comprehension modules are selectively impaired.

Criterion 3: Task Sensitivity

Hillis and Caramazza (1989) discussed the case of an aphasic subject who produced the same kind and amount of spelling errors in a variety of expressive tasks: oral naming, writing words and nonwords to dictation, and delayed copying. Essentially, they argued that the hypothetical graphemic buffer—not the lexicon or the different output systems (speaking, writing, and copying)—was selectively impaired. These investigators discussed a theory that the graphemic buffer holds words during the production of various output endeavors, such as oral or written spelling.

According to Hillis and Caramazza, lexical factors, such as word frequency and concreteness, did not have a differential effect on spelling. Therefore, they argued that these aspects of the lexicon did not affect spelling accuracy. Modality of response (spelling either to dictation or aloud) also had no effect on spelling error rates, resulting in equiva-

lent error rates across lists of words in these categories. The only factor that did influence spelling performance was the length of the word in letters. Longer words were less accurately spelled than shorter words. This was interpreted to indicate a deficient ability to hold abundant information in the buffer. Data came, however, from performance on an unpublished test battery, the design of which may put the authors' claims in question.

The battery presents vastly different numbers of test stimuli in different categories. For instance, in the written naming task, there were no errors on words of three letters and 42.9% error on words of five letters, which would seem to support the authors' claims of greater error on longer words. However, the battery contained only 2 three-letter words compared with 21 five-letter words. To compare percentage of error across such discrepant numbers of stimuli may misrepresent the subject's actual capability.

The Nespoulous et al. study (1988) provides another example of possible task insensitivity. Although their subject's performance was error-free on the syntactic comprehension tasks, it is not clear that this level of performance means that comprehension was intact (i.e., at normal levels). The comprehension tasks may have been too easy to reveal deficits in this subject. Either aphasic or normal performance data on these tasks would serve to ascertain the tasks' ability to reveal deficits in mildly impaired subjects.

CONCLUSION

This analysis illustrates some troubling methodological weaknesses in the studies reviewed, particularly regarding test–retest reliability, task difficulty, and task sensitivity. To the extent that these concerns cannot be explained or eliminated, the studies fail to support the notion of selective impairment in these aphasic subjects. With support for the concept of selective impairment of components of the language system now possibly diminished, its principles, as applied to clinical aphasiology for diagnosis, as Caplan (1993) has called for, and treatment, as Byng (1988) has supported, must be called into question.

Future efforts to understand and specify the nature of cognitive organization in aphasic language behavior will be enhanced by attention to three major concerns, including not only psychometric properties of experimental design, but also the logic of inferential arguments and the robustness of the basic tenets of a modular theory of language organization. Although this paper has focused on methodological issues,

a brief mention of another line of inquiry is appropriate. One concern regarding logical argument is that, although single or double dissociations typically are accepted as evidence of more than one processing subsystem underlying the performance differences, dissociations of this sort do not unambiguously point to multiple independent processing systems. Dunn and Kirsner (1988) argued that better evidence for inferring two or more independent underlying processing subsystems is the presence of a reversed association. In general terms, a reversed association is identified when two tasks are affected similarly by a variable in one study but affected in the opposite way by a different variable in a second study (Dunn & Kirsner, 1988).[1] A full discussion of this concept and its potential value is not possible in this article, but a serious look at this notion is warranted.

A second concern in the realm of logical analysis is that the nature of the tasks themselves, and the resulting performance dissociations, may be incapable of revealing the number and kind of underlying processes. Typically, experimental language tasks, especially those assessing comprehension, entail end-point performance, that is, final responses that result from the integration of information from all component processing systems. End-point responding occurs in "off-line" tasks, in which no response is made until all immediate processing for the task has yielded a conclusion and in which there are only minimal time constraints on the speed of response. The response is produced when the subject subjectively feels sufficiently confident to respond. In any off-line output, the source of the disruption contributing to the final error is potentially obscured in the integrated matrix of the final response. In contrast are "on-line" tasks which place a time constraint on responding. These tasks may well be preferable to off-line tasks in inferring underlying processing because responses are presumably closer to the real-time operation of processing and can thus reveal the nature of the processing disruption more accurately. In addition, these real-time tasks can be designed to interrupt ongoing processing and demand a first-pass response before the final output, thus possibly revealing the stage of disputed processing.

Efforts to understand and specify the nature of the cognitive organization of aphasic language behavior will be enhanced by attention to several issues, including the vigor of dissociation claims, the logic of inferential arguments, and the robustness of the basic tenets of a modular theory of language organization.

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