

# Processing of disyllabic compound words in Chinese aphasia: Evidence for the processing limitations account<sup>☆</sup>

Chia-Lin Lee,<sup>a,b,\*</sup> Daisy L. Hung,<sup>a,b,c</sup> John K.-P. Tse,<sup>d</sup> Chia-Ying Lee,<sup>a,b</sup>  
Jie-Li Tsai,<sup>b</sup> and Ovid J.-L. Tzeng<sup>a,b</sup>

<sup>a</sup> *Laboratory for Cognitive Neuropsychology, National Yang Ming University, Taipei 112, Taiwan, ROC*

<sup>b</sup> *The Institute of Linguistics, Academia Sinica, Taiwan, ROC*

<sup>c</sup> *Graduate Institute of Cognitive Neuroscience, National Central University, Taiwan, ROC*

<sup>d</sup> *Graduate Institute of Linguistics, English Department, National Taiwan Normal University, Taiwan, ROC*

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## Abstract

The current study addresses the debate between so-called ‘structural’ and ‘processing limitation’ accounts of aphasia, i.e., whether language impairments reflect the ‘loss’ of linguistic knowledge or its representations, or instead reflect a limitation in processing resources. Confrontation-naming task and category-judgment tasks were used to examine and compare the performance of non-fluent and fluent aphasics on different compound types of nouns and verbs. We demonstrate that aphasic patients’ performance is modulated by the canonicity of the particular compound type, a result that holds true even for the category in which patients show a ‘selective category deficit.’ These findings weigh against the ‘loss’ of linguistic representations as the underlying cause of noun–verb deficits, instead supporting a ‘processing limitations’ approach.

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## 1. Introduction

Since the 1970s, much research on language breakdown has been aimed at understanding the relationship between the disrupted language performance of aphasic patients and the site of their brain lesions, with the goal of uncovering the structure of the human cognitive system for language. The study of selective deficits has been particularly emphasized, given that “strong neuropsychological evidence for the existence of neurologically distinct functional systems depends on double dissociation of function” (Shallice, 1979, p. 260). Accordingly, many investigators (for example, Caramazza, 1986; Grodzinsky, 2000) suggest that language impairments can be considered indices of the ‘loss’ of linguistic

structure, where selective or dissociable language deficits are taken to evidence the boundedness or modularity of the linguistic representation or the mechanisms underlying processing. ‘Agrammatism’ is perhaps the best example of this approach. So-called agrammatic aphasics are notable for their limitations in the use of pure grammatical elements (‘closed-class’ words) such as auxiliaries, inflections, and (non-lexical) prepositions (Goodglass, 1993); more controversially, agrammatic aphasics are said to suffer from a ‘central syntactic deficit,’ where aspects of syntactic knowledge are lost (e.g., the ‘Trace Deletion Hypothesis,’ Grodzinsky, 1990, 1995, 2000).

Agrammatism is said to be a hallmark of patients with Broca’s aphasia (Grodzinsky, 2000); these patients are also distinguished by their effortful and labored speech output, with relatively spared auditory comprehension (Goodglass, 1993). Conversely, Wernicke’s aphasic patients are said to be ‘paragrammatic,’ in that they often speak fluently but with a high rate of

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\* Corresponding author. Fax: +886-2-2820-4903.

E-mail address: [charlene@daisy.ym.edu.tw](mailto:charlene@daisy.ym.edu.tw) (C.-L. Lee).

substitution errors; these patients also are severely impaired in their auditory comprehension of language, and have particular problems with open-class words. Broca's and Wernicke's aphasics can also be distinguished by their performance in semantic priming paradigms. Several studies (e.g., Blumstein, 1997; Blumstein & Milberg, 2000) showed that Broca's aphasics show very little semantic priming in online lexical decision tasks (particularly in the face of acoustically degraded exemplars) but are able to make off-line semantic judgments. In contrast, Wernicke's aphasics tend to show exaggerated semantic priming in such online tasks, but perform at chance levels for off-line semantic judgment tasks. Finally, Broca's and Wernicke's aphasics show dissociable profiles of noun/verb production and comprehension, with Broca's aphasics said to show deficits in verb use, and Wernicke's aphasics showing deficits in noun use (Caramazza & Hillis, 1991). The putative double dissociations observed in Broca's and Wernicke's aphasic patients are often cited as evidence for cognitive and neural modularity—a position succinctly stated by Shallice (1988, p. 248): “If modules exist, then . . . double dissociations are a relatively reliable way of uncovering them. Double dissociations do exist. Therefore modules exist.”

However, there is increasing evidence arguing against the above position. To begin with, the results of studies purporting to show a double dissociation between nouns and verbs tend to show a gradient of deficits instead of a distinct all-or-none contrast between the two grammatical categories. Moreover, despite the limitations of the grammaticality/acceptability judgment task (Linebarger, Schwartz, & Saffran, 1983; Zurif & Grodzinsky, 1983), the finding that agrammatic patients can make grammaticality judgments with above-chance accuracy strongly suggests that these aphasic patients' syntactic knowledge is actually not 'lost,' a situation that is problematic for the 'structural deficit hypothesis' (Lu et al., 2000; Shankweiler, Crain, Gorrell, & Tuller, 1989; Wulfeck & Bates, 1991; but see discussion in Linebarger et al., 1983; Zurif & Grodzinsky, 1983 concerning limitations of the grammaticality judgment task). In addition, there is increasing evidence that there is no systematic relationship between clinical aphasic classification and deficits in discrete aspects of language use (Bates, Wulfeck, & MacWhinney, 1991; Blumstein, 1997). Indeed, aphasic patients' behavioral patterns are often paralleled in neurologically intact subjects in a wide range of language assays, including phonological deficits in speech production, perceptual errors in speech perception, as well as production and comprehension of morphology, sentence comprehension, and the production of grammatical errors. (Aydelott & Bates, 2004; Blackwell & Bates, 1995; Crain, Ni, & Shankweiler, 2001; Dick, Bates, & Ferstl, 2003; Dick et al., 2001; Goodglass & Menn, 1985; and see Bates & Wulfeck,

1989; Blumstein, 1997 for comprehensive reviews.) In these studies, different groups of aphasic patients and normals under stress demonstrate similar patterns, performing more poorly as linguistic structure becomes more complex and/or difficult.

In view of these data, several investigators have suggested a different theoretical approach, one that attributes the decrement of language ability in aphasic patients to limitations in processing capacity (Bates & Wulfeck, 1989; Blackwell & Bates, 1995; Blumstein, 1997; Blumstein & Milberg, 2000). On this view, aphasic patients' language difficulties are often caused by deficits in accessing and processing representations, rather than resulting from damage to the representation itself. This approach considers language comprehension and production to be dynamic processing operations that occur under severe time constraints (Blumstein, 1997). Graded disruptions of this dynamic system may cause seemingly isolable language impairments in phonological, lexical, and semantic processing, ones that appear to segregate aphasic subgroup. For instance, Blumstein and Milberg (2000) suggest that changes in lexical activation profiles can account for the pattern of semantic deficits observed in Broca's and Wernicke's aphasics. Bates and Wulfeck (1989) suggest that “dissociations can occur in a highly interactive system, if the whole system changes in ways that affect some items more than others. Selective sparing and impairment may result from perturbations in timing, from restrictions on a data source that is especially important for a given class of items, and/or through adaptations that the patient make to his aphasic condition (that is, self-induced task demands). We do not have to postulate separate modules for each item type, or disconnections in the wires running from one component to another. (p. 329)” As pointed out by Bates and Wulfeck (1989), and demonstrated in computational simulations (Juola & Plunkett, 1998; Plaut, 1995) double dissociations can emerge from the interaction of resource requirements and the processes of lexical access without the presence of any 'modular' lesions (also see McClelland & Rumelhart, 1986; Rumelhart & McClelland, 1986).

The present study tests predictions of the structural and processing deficits hypotheses by investigating the apparent double dissociation between nouns and verbs in fluent and non-fluent aphasics by testing their ability to produce or categorize various subtypes of nouns and verb. As noted above, differences between Broca's and Wernicke's aphasics in their ability to use and comprehend nouns and verbs has been cited as strong evidence for 'loss of linguistic representations' and the modularity of language. For instance, results of several studies show that in connected speech, main verbs, and object nouns can be selectively dropped in different groups of aphasics. Non-fluent and agrammatic aphasic patients tend to produce far fewer verbs than nouns (McCarthy &

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