Brain and Language

The interaction between semantic and sublexical routes in reading: Converging evidence from Chinese

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Introduction

The classic dual route model for reading (Coltheart, Rastle, Perry, Langdon, & Ziegler, 2001) assumes at least two independent routes from printed input to sound: one via a lexical-semantic pathway and one via a nonlexical pathway which relies on a process of grapheme-phoneme-conversion (GPC) and leads to an effect of regularity on reading. However, there is evidence from brain-damaged patients that these pathways are not fully independent but instead interact (Hillis & Caramazza, 1995). Although in some patients, impairment prevents either of these routes from independently producing the correct response for a target, the imperfect activation from both routes may summate onto the target leading to a correct response. Weekes Chen, and Yin (1997) reported that oral reading in Chinese can proceed via an independent pathway that bypasses lexical-semantic knowledge. Weekes and Chen (1999) argued this pathway does not support reading of low imageability, low frequency irregular characters resulting in an effect of regularity on reading. This *sublexical* process on oral reading in Chinese differs from the process of GPC in alphabetic languages. A Chinese character can be considered regular if it contains a visual component (phonetic radical) that can be an independent lexical item with the same pronunciation as the whole character. A character is consistent if all characters containing this phonetic radical have the same pronunciation. Sublexical regularity and consistency play a role in character reading independent of lexical factors in studies with normal (Hue, 1992) and aphasic groups (e.g., Weekes & Chen, 1999). We focus here on the reading of a patient, WJX, who suffers from dementia and who made semantic errors in comprehension and production. His reading ability was well preserved, even for many irregular/inconsistent characters. Our question was what reading process can account for his good reading performance?

Case description and results

WJX is a 75-year-old right-handed man who received a high-primary school education and worked as a clerk in a police bureau of Beijing. His family reported four years of deteriorating memory. WJX scored 16 on the Chinese version of the MMSE indicating probable dementia. A CT scan revealed a small low-density focus in the posterior limb of the left internal capsule. He performed well on tests of repetition (39/40), buccofacial apraxia (15/15), and copying (10/10). His semantic impairment was apparent in both comprehension and production tasks using items from Snodgrass and Vanderwart (1980). The correct items were 91/162 and 67/162 on spoken and written word/picture verifications tasks, respectively, and 101/226 on picture naming. Semantic errors were frequent in all of these tasks (41, 29, and 47%). By contrast, he read orally the same items, which included irregular/inconsistent characters significantly better (213/226, $\chi^2 = 130.845$, $p < .0001$). Why could WJX read many irregular/inconsistent characters despite his semantic impairment? We compare his comprehension and reading ability on an item-by-item basis. Given a character, he was asked to first tell the examiner what it meant, then read it aloud. Three character types were used to examine sublexical characteristics following the criteria above: (1) regular/consistent; (2) regular/inconsistent, and (3) irregular/inconsistent. Results are shown in Fig. 1. When WJX could retrieve accurate or partial semantic information, e.g., knowing a "peach" is a fruit, he read all characters including irregular/inconsistent characters correctly (66/66). However, when reading characters for which he could not give any semantic information at all, there was a significant effect of consistency (69% vs. 37%, $\chi^2 = 5.916$, $p = .015$). Thus, WJX used correspondences between orthography and phonology to read aloud that are *sublexical*.

Discussion

WJX's reading behavior cannot be explained by the operation of a lexical-semantic route or a nonsemantic route alone. His conceptual representations seemed to be impaired since he

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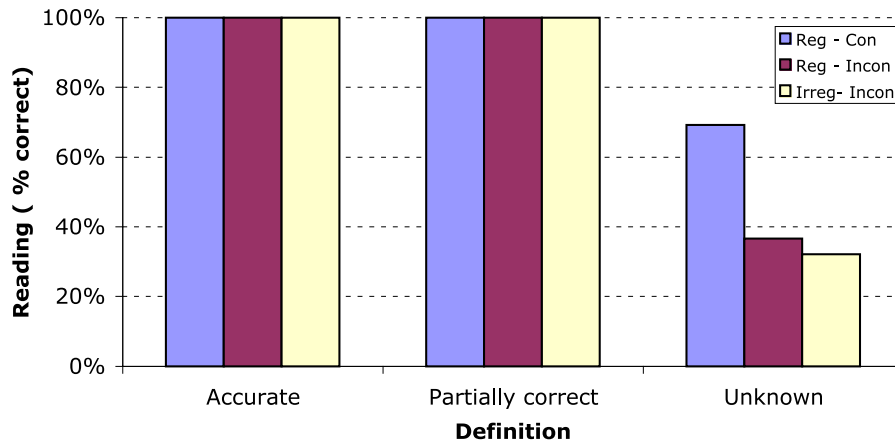 *E-mail address*: B.S.Weekes@sussex.ac.uk (B.S. Weekes).

Fig. 1. Correct percentage of reading by WJX as a function of his comprehension.

made many semantic errors in all production and comprehension tasks. The nonsemantic route cannot reliably give the correct response for irregular/inconsistent characters either. The summation account (Hillis & Caramazza, 1995), which assumes activation from the conceptual system and a sublexical route summate in oral reading, can account for WJX's reading performance. For instance, upon seeing the character 猫/mao1/cat, an impoverished conceptual representation may be activated, which in turn activates a cohort of semantically related candidates e.g. 猫/mao1/cat, 狗/gou3/dog. The phonetic radical of the character, 苗""/miao2/, on the other hand, activates a cohort of pronunciations corresponding to it through a nonsemantic route e.g. /mao1/, /mao2/. The summation of information from these two routes generates the correct response /mao1/. When no conceptual information can be activated by a character, the semantic route offers no information, and only sublexical correspondences can be used. In this case, the phonetic radical consistency effect becomes visible. Again, we need to point out that the sublexical process in Chinese cannot be equivalent to a GPC process in alphabetic languages (see Weekes & Chen, 1999). What is important is that this process is not necessarily a direct mapping between a character as a whole and its phonological representation. More significantly, this sublexical process and the semantic route work together and allow WJX to achieve correct responses in oral reading. To conclude, the principle notion of the summation hypothesis finds converging evidence in Chinese, a logographic language.

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