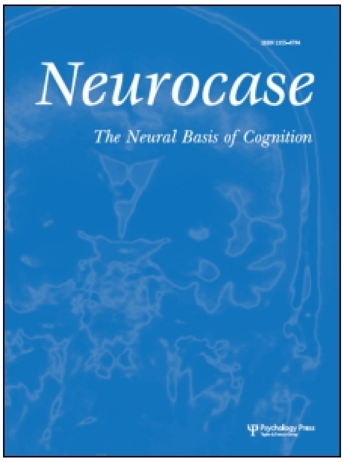

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Anomia without Dyslexia in Chinese

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Abstract

It is often assumed that oral reading of Chinese script proceeds from print to phonological output via semantic representations (e.g. Wang WS-Y. The Chinese language. Scientific American 1973; 228: 50–60). However, it is possible (at least in principle) that Chinese characters can be read aloud without access to the mappings between semantic representations and phonological output that are presumed to underlie normal spoken word production. We report the confrontation naming and oral reading performance of a Chinese anomic patient, YQS, whose word comprehension, word repetition and oral reading skills are intact. When her retrieval of names from pictures is compared with her retrieval of the same names from print, there is a highly significant advantage of oral reading over picture naming ($P < 0.0001$). Indeed, her oral reading of hundreds of Chinese characters is flawless. We argue that the data from YQS show that oral reading in Chinese does not require access to the mappings between semantic representations and phonological output, but instead can proceed via a non-semantic reading pathway that maps orthographic units, such as radicals and characters, directly onto phonological output.

Introduction

Anomia is an acquired impairment to name retrieval that often results from lesions to the left cerebral hemisphere. Most of the anomic patients reported in the neuropsychological literature have been native speakers of alphabetic languages, such as English and Italian (e.g. Breen and Warrington, 1994, 1995; Chertkow *et al.*, 1992; Gianotti *et al.*, 1981, 1986; Howard and Orchard-Lisle, 1984; Howard *et al.*, 1985; Kay and Patterson, 1985; Kay and Ellis, 1987; Schwartz *et al.*, 1979; Warrington and Shallice, 1984; Zingeser and Berndt, 1988). Much less is known about the characteristics of anomia in non-alphabetic languages such as Chinese and Japanese.

Alphabetic scripts are characterized by a finite number of symbols that can be combined to produce an infinite number of words, whereas non-alphabetic scripts contain a much larger number of symbols, each of which uniquely represents an individual word. The Japanese script is usually referred to as a *syllabary* (Henderson, 1982). This means the script has a systematic set of signs that represent syllable sounds, independent from word meanings. There are two different types of Japanese script. These are morphographic *Kanji* which are derived from Chinese logographs, and two forms of syllabic *Kana* (*Katakana* and *Hiragana*), that are unique to the Japanese writing system (the reader is referred to Patterson *et al.*, 1995, for a more detailed discussion of the Japanese script).

The Chinese language is also non-alphabetic. It contains over 50000 different characters. Many of the ancient Chinese characters were *pictographic*, which means that the written character portrayed the basic form of the object it represented. A small number of these characters are still in use today. For example, the character for horse, 马 'ma' is a pictograph. To some readers this character suggests an abstract figure galloping across the page (e.g. Wang, 1973). The modern Chinese writing system is usually considered to be a *logography* (Henderson, 1982). This means that the basic unit in Chinese writing (the character) is associated with a unit of meaning (morpheme) in the spoken language, unlike the letters in an alphabet which do not represent meaning.

The idea that modern Chinese is a pure logography has been challenged. De Francis (1989) argued that there are actually four different types of character in modern use: (1) *pictographic* characters which represent a specific object (e.g. 日 'ri' meaning 'sun'); (2) *indicative* characters which represent abstract meanings that cannot be easily sketched (e.g. 本 'ben' which means 'base' and is derived from 木 'mu' meaning 'tree'); (3) *associative* characters

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which combine existing characters to produce a new meaning (e.g. 尘 'chen' which means 'dust' and is derived from 小 'xiao' meaning 'small' and 土 'tu' meaning 'earth'); and (4) *phonetic-compound* characters which are constructed from a meaning component called the *semantic radical* and a pronunciation component called the *phonetic radical* (e.g. 狐 'hu' meaning 'fox').

Phonetic compounds are the most common type of Chinese character (over 80% of all characters are phonetic compounds). However, even though the majority of Chinese logographs contain a phonetic radical, the information contained in the phonetic radical is usually an unreliable guide to its pronunciation (Yin and Butterworth, 1992). It is virtually impossible to read aloud a Chinese logograph correctly by decoding its component radicals (Patterson, 1981), unlike alphabetic scripts where it is possible to read aloud many unknown words by decoding their constituent parts. Moreover, knowing which component in a character is the phonetic radical and which is the semantic radical cannot be determined on the basis of orthographic information alone. Phonetic radicals can be positioned to the left or to the right (or the top or the bottom) of a character. For example, the phonetic radical 'qi' 其 is on the right for the character 棋 which means 'Chinese chess', but it is on the left for the character 期 which means 'a period of time'. Character components can act as both the phonetic radical and the semantic radical in two different words. For example, the character 木 which means 'wood' is a semantic radical in over 1500 Chinese characters, including 棋 'qi', however, it is also the phonetic radical in the character 沐 'mu' which means 'wash'. To read a Chinese character correctly, the reader must know the pronunciation that is associated with the character as a whole.

Cognitive neuropsychological investigations of the oral reading of anomic patients have made a substantial contribution to our conceptual understanding of oral reading in alphabetic languages (e.g. Breen and Warrington, 1995; Besner, 1996; Cipolotti and Warrington, 1995; Lambon-Ralph *et al.*, 1995; Patterson *et al.*, 1995; Plaut *et al.*, 1996). It is often assumed that oral reading of Chinese characters must proceed from print to phonological output via semantic representations (e.g. Chen *et al.*, 1988; Smith, 1985; Wang, 1973). However, it is possible (at least in principle) that Chinese characters can be read aloud without access to the mappings from semantic representations to output phonology (cf. Henderson, 1982).

There are few published reports of the oral reading skills of anomic patients who premorbidly spoke non-alphabetic languages, that bear directly upon the issue of whether oral reading of logographs requires access to the mappings between semantic representations and phonological output. There is evidence from Japanese aphasic patients that logographic Kanji characters can be read aloud without access to their semantic representations (Sasanuma *et al.*, 1992), but it has yet to be established whether or not Chinese logographs can be read aloud without semantic mediation (Yin and Butterworth, 1992). Moreover, the many differences that exist between oral reading in Japanese and Chinese make comparisons between these two languages difficult. Logographs in Chinese only have one pronunciation, whereas logographs in Japanese usually have at least two pronunciations: an *On*-reading (which is based on the original Chinese pronunciation) and a Japanese *Kun*-reading. A Japanese reader must decide which of these pronunciations should be used, based on the background within which the character is set (Wydell *et al.*, 1993). By contrast, a logograph in Chinese is always pronounced in exactly the same way, regardless of context. Another difference is that there are a large number of homophonic characters in Chinese, whereas homophony is far less common in the Japanese script.

Hu *et al.* (1983) compared the confrontation naming performance and the oral reading performance of Chinese aphasic patients and found that anomia is often associated with dyslexia in Chinese. This association between naming and oral reading impairment led Hu *et al.* (1983) to argue that the spoken language system supports oral reading in Chinese. In other words, Hu *et al.* (1983) believe that oral reading in Chinese depends upon the mappings that link semantic representations with phonological output. This claim is consistent with the assertion that oral reading must proceed via semantic representations in Chinese.

There is other evidence, however, that naming and oral reading in Chinese may be dissociable skills. In a classic case report, Lyman *et al.* (1938) reported a bilingual (Chinese–English) patient with a large occipito-parietal tumour in the left hemisphere, who was dyslexic in Chinese but not in English. When this patient was presented with Chinese characters to read aloud, he could read only two characters, whereas his oral reading of English words was nearly perfect (19/20 correct). This patient's impaired oral reading of Chinese characters was accompanied by fluent speech in Chinese and English and intact verbal comprehension in both languages. The data from Lyman *et al.*'s patient suggest that spoken word production and oral reading are dissociable skills in Chinese. Further, if it is assumed that, for this patient, spoken word production in Chinese proceeds via a pathway that links semantics with phonological output, then the dissociation between naming and oral reading in Chinese shows that this pathway is not sufficient to support oral reading of Chinese script (but may support oral reading of English words in a bilingual speaker). These data are inconsistent with the view that oral reading of Chinese characters must proceed from print to phonological output via semantic representations.

One counter-argument to the above claim is that oral reading in Chinese may be a more difficult skill than spoken word production. This makes intuitive sense given that spoken language is biologically given and learned without formal tuition, whereas written language is unnatural, invented and requires intensive tuition. Thus, if it is accepted that oral reading is a more difficult skill than spoken word production in Chinese, then oral reading may be more likely to become impaired following brain damage simply because of differences in task difficulty and not because oral reading is independent of spoken word production.

Putative differences in task difficulty between confrontation naming and oral reading in Chinese make the dissociation displayed by patients such as Lyman *et al.*'s rather difficult to interpret. This limits the contribution that the data from such patients can make to our conceptual understanding of oral reading in Chinese. If, however, one could find a patient who displayed the opposite dissociation to Lyman *et al.*'s (i.e. impaired naming but intact oral reading of Chinese characters), then such a patient would demonstrate beyond reasonable doubt that naming and oral reading in Chinese are in fact dissociable skills. We report such a case below.

Case description

Subject details

YQS is a 53-year-old, perfectly right-handed woman. Handedness was assessed with the Chinese version of the Edinburgh Inventory–Reitan Dominance Scale reported by Cheng and Yang (1989). During October 1992, YQS was admitted to her local hospital immediately following a cerebrovascular accident (CVA). She was conscious on admission to hospital. A CT scan performed shortly after admission showed evidence of haemorrhage in the region of the basal ganglia. This CT scan is reproduced in Fig. 1a. A neurological examination conducted at the time of admission found that YQS was mute and that she had a right-sided hemiparesis (affecting her right arm more than her right leg), but there was no evidence of sensory impairment. A second CT scan performed 3 months after admission showed evidence of mild left ventricular dilation. This CT scan is reproduced in Fig. 1b.

YQS is a native speaker of the Putonghua (Mandarin) dialect and is considered to have been a highly literate person in that language, having been employed as a senior primary school teacher prior to the CVA. She speaks some English but is not truly bilingual.

YQS was first seen for neuropsychological assessment at the China-Japan Friendship Hospital in Beijing 24 months after her first admission to hospital. All testing was carried out in Mandarin by a specialist in rehabilitation medicine. At the time of testing YQS was alert, co-operative, and well oriented for time and place. Her speech was hesitant and dysfluent and marked by frequent semantic paraphasias (phonemic paraphasias were absent). Despite the severe naming impairment, YQS could respond to many commands with an appropriate gesture, indicating that her auditory–verbal comprehension was intact. The results of neuropsychological testing are summarized in Table 1.

On the Chinese translation of the Mini Mental State Examination (Folstein *et al.*, 1975), YQS achieved a near perfect score (she lost one point for an error when writing a sentence). She could copy Chinese script and write her own name without error. However, on the Chinese version of the Boston Naming Test (Hu, personal communication), YQS was significantly impaired (scoring only 56% correct). During testing she did a great deal of pointing and gesturing with her left hand, indicating that she understood the picture to be named. On a test of oral repetition, YQS could repeat monosyllabic and polysyllabic words without error. However, on a test of controlled oral word

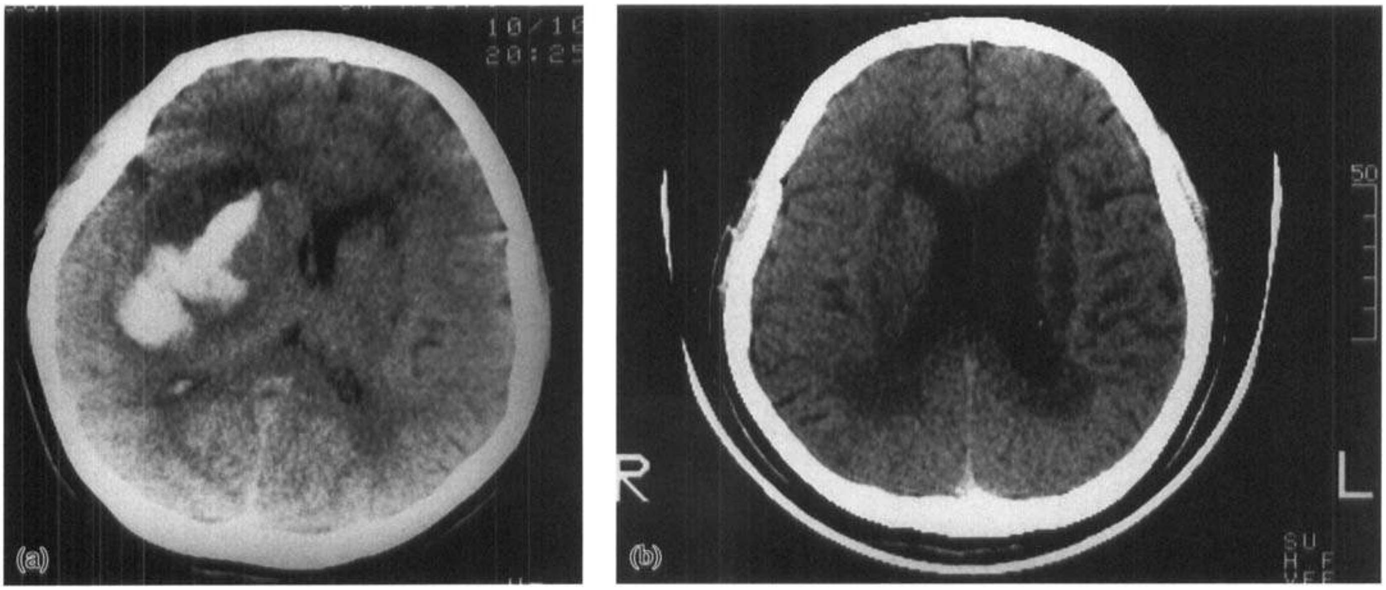

Fig. 1. (a) A CT section showing an area of high density in the region of the basal ganglia. (b) A CT section showing mild ventricular dilation in the left lateral ventricle.

Table 1. Results of testing (number correct) for patient YQS

Test	Score
Mini Mental State Examination (Chinese version)	29/30
Boston Naming Test (Chinese version)	34/60
Spoken Word Repetition	26/26
Oral reading	
High-imageability/high-frequency words	20/20
High-imageability/low-frequency words	20/20
Low-imageability/high-frequency words	20/20
Low-imageability/low-frequency words	20/20
Writing characters	47/60
Category fluency	9 names in 3 minutes
Animals	6 (cow, sheep, horse, rabbit, zebra, rhinoceros)
Edible objects	2 (asparagus, aubergine)
Musical instruments	1 (violin + perseveration)

association her fluency was sparse. YQS could generate only nine names when given 60 s to generate as many names as possible from three different semantic categories. On tests of single-character writing, YQS made stroke-substitution, stroke-omission and stroke-addition errors in approximately equal measure.

Tests of semantic knowledge

In order to assess YQS's knowledge of objects, written words and spoken words, she was given three different

Table 2. Number correct on three tests of language comprehension

Test	Score
Word–category assignment	48/48
Written word–picture matching	20/20
Picture–picture matching	20/20

tasks. The results from each test are summarized in Table 2.

The first task was a word–category assignment test. YQS was given 48 cards upon which a Chinese word was printed (words could be made up of one or more characters). Half of the words were the names of common animals (e.g. duck, cow, sheep) and the other half were the names of common fruits and vegetables (e.g. watermelon, grapes, tomato). She was asked to sort these stimuli into two equal groups of animate and inanimate objects according to their category membership. YQS performed this task with 100% accuracy.

The second task was a 20 item written word–picture matching test. An example stimulus is shown in Fig. 2. On this task, a printed word was placed in the centre of a single sheet of A4 size paper. The word was surrounded by four randomly arranged line drawings. One of these line drawings was the target and the remainder were foils. The target was defined as the line drawing that matched the word presented in the centre of the page. The three foils were (1) a semantically related foil that came from the same semantic category as the target; (2) a phonologically related foil that had a similar sounding name to the target; and (3) an unrelated foil that was not related in meaning or

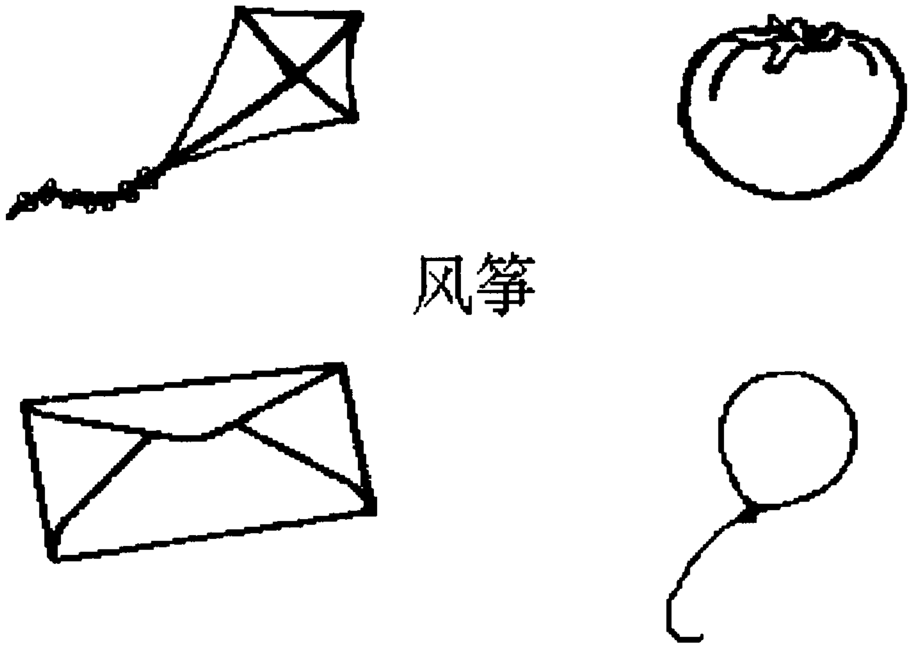

Fig. 2. Example stimulus from the word–picture matching task. The target word is pronounced 'feng zheng' which means *kite*. The pronunciation of the semantically related foil is 'qi qiu' which means *balloon*. The pronunciation of the phonologically related foil is 'xin feng' which means *envelope*. The pronunciation of the unrelated foil to the target is 'xi hong shi' which means *tomato*.

sound to the target. The target was defined as the picture that matched the word in the centre of the page. YQS was asked to point to the target picture with her left index finger but not to read the word aloud, so as to prevent auditory recognition of the target word. She performed this task with 100% accuracy.

The third task was a 20 item picture–picture matching test similar to the Pyramids and Palm Trees test developed by Howard and Patterson (1992). An example stimulus is shown in Fig. 3. On this task, three line drawings were presented on an A4 size piece of paper. One line drawing was placed above the other two and also inside a square boundary. The other two line drawings were placed directly below the target (one slightly to the left and the other slightly to the right of centre). YQS was asked to point to the line drawing below the target that was closest in meaning to the target. She performed this task with 100% accuracy.

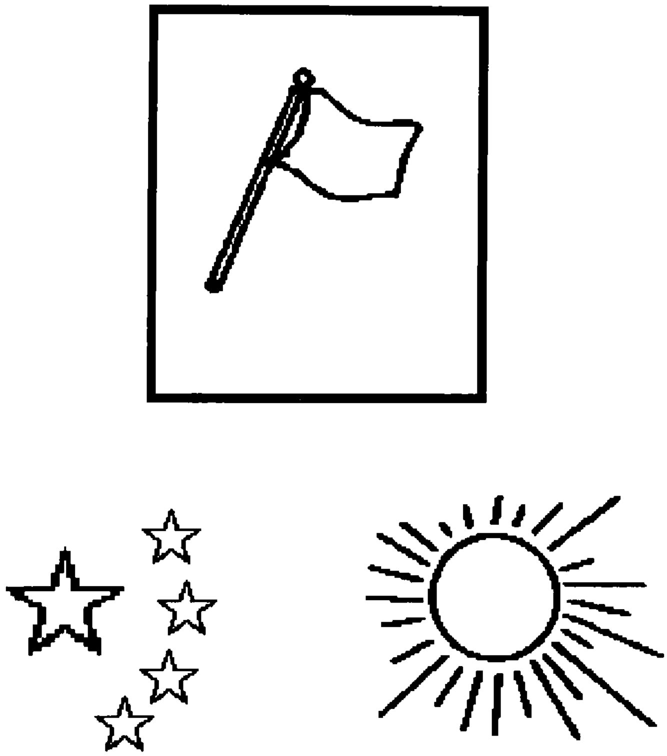

Fig. 3. Example stimulus from the picture–picture matching task.

Tests of oral reading

YQS was given a test of oral reading that comprised 40 target words. High-imageability items were defined as words with clear sensory referents (e.g. elbow, potato, feather) whereas low imageability items were defined as words without a sensory referent (e.g. treason, principle, idea). High-frequency items had a frequency of occurrence that was equal to or greater than 50 occurrences per 10 000 in written Chinese, and low-frequency items had a frequency of occurrence that was equal to or less than 10 occurrences per 10 000 according to norms reported by the Beijing Institute of Language (1986). YQS performed this task perfectly.

Summary

YQS shows many of the classic signs of anterior subcortical aphasia that are also found in English-speaking and Italian-speaking patients who have a similar aetiology (Alexander *et al*., 1987; Basso *et al*., 1987; Cappa *et al*., 1983; Damasio *et al*., 1982; Kertesz, 1989; Tanridag and Kirschner, 1985). These signs include non-fluent, paraphasic conversational speech, impaired confrontation naming and dysgraphia, accompanied by intact comprehension of picture and word stimuli and intact spoken word repetition (Crosson, 1992). As such, the data from YQS add to the growing body of evidence showing that the subcortex plays a role in Chinese language processing (Gao and Benson, 1990; Hong *et al*., 1984; Yang *et al*., 1989; Zhu *et al*., 1984). The pattern of impaired naming accompanied by preserved word comprehension and word repetition shows that YQS's confrontation naming impairment is not pre-semantic, nor is there any impairment to output phonology.

We contend that YQS has a highly specific impairment to name retrieval, which prevents her from accessing phonological output. It is precisely this skill that is presumed by Hu *et al*. (1983) to underlie oral reading of Chinese characters. The fact that YQS is anomic but can read flawlessly suggests that oral reading and confrontation naming are dissociable skills in Chinese. However, in order to determine whether this thesis is correct, it must be demonstrated that oral reading is intact but confrontation naming is impaired for the same set of items.

Experimental investigation of picture naming and oral reading

The primary aim of the experiment was to compare YQS's name retrieval from pictorial input with her retrieval of the same names from print, in order to determine whether or not there is a dissociation between confrontation naming and oral reading in Chinese. We hypothesized that if oral reading in Chinese depends upon a pathway that maps print onto phonological output via semantic representations (cf. Hu *et al*., 1983), then YQS should be unable to read aloud those names that she cannot generate on a picture-naming task. However, if oral reading in Chinese can proceed via a non-semantic pathway that maps print directly onto output phonology (without first contacting semantic representations), then YQS should be able to read aloud names that she cannot retrieve from pictorial input.

Method

Materials

(a) Picture naming task

Targets in the picture naming task were 233 line drawings of common objects (e.g. airplane, rabbit, violin). Picture stimuli were individually printed on plain white laminated index cards (8 cm × 16 cm). Stimuli were digitized reproductions of a set of 260 pictures reported by Snodgrass and Vanderwart (1980). Twenty-seven line drawings from the original set of 260 line drawings were excluded because they were found by Hua *et al.* (1992) to be very unfamiliar to Chinese speakers (e.g. toaster, baseball bat, football helmet).

(b) Oral reading task

Targets in the oral reading task were the printed names of the 233 line drawings used in the picture naming task. The majority of characters (over 80%) were phonetic compound characters. The written word frequency of the characters ranged from one occurrence per 10 000 to over 100 occurrences per 10 000 according to norms published by the Beijing Institute of Language (1986). Word stimuli were individually printed on plain white laminated index cards (8 cm × 16 cm). Of the 232 printed names, 37 (16%) were single-character names; 168 (72%) were two-character names; 27 (10%) were three-character names; and two (1%) were four-character names.

Procedure

The experiment was performed in two different phases, separated by a 12-month period. The first phase was carried out 24 months after YQS's first admission to hospital; and the second phase was carried out 12 months later. There were two separate test sessions during each phase of testing, and each session was separated by 1 week. In the first session, YQS was asked to name line drawings. These were presented in four equal blocks of 58 trials with a 5-minute rest period between each block. In the second session, YQS was asked to read aloud printed characters (she chose to perform this task without taking a break). The same procedure was repeated in the second phase of testing. On all trials, stimuli were presented for a maximum of 60 s or until a response was given. All oral responses were recorded manually by four Mandarin-speaking judges and also audio-tape recorded for later error analysis.

Results

Treatment of data

A spoken name was scored correct if all four judges agreed that it was a correct response. Spoken Chinese has a relatively large number of synonyms (e.g. there are at least three names that can be used to describe the sun: 'tai yang', 'yan guang' and 'ri guang'). Thus, if a synonymous name was produced by YQS in the picture naming task it was always scored as correct. However, all other incorrect responses on the picture naming task were scored as errors. YQS made four types of error. These were semantic errors (42% in phase 1 and 41% in phase 2) defined as a response where there was a clear associative relationship between the target and the response (e.g. *apple* read as 'orange'); incomplete responses (19% in phase 1 and 21% in phase 2), defined as a response that contained at least one correct syllable in a polysyllabic name (e.g. *da xing xing* [gorilla] read as 'da'); phonological errors (1% in phase 1 and 2% in phase 2), defined as a response that was phonologically similar to the target (e.g. *mian* read as 'bian'); and unrelated errors (39% in phase 1 and 38% in phase 2), defined as responses that were neither semantic, incomplete nor phonological. YQS also sometimes produced an English name for a line drawing that she could not name in Chinese (e.g. *xiao tiqin* → 'violin').

Comparison of picture naming and oral reading performance

YQS's test results on the picture naming and oral reading tasks in both phases are summarized in Table 3. On the picture naming task, YQS scored 56% correct in phase 1 and 60% correct in phase 2 (this shows that there was no deterioration in picture naming performance over a 12-month period). The item-to-item correlation coefficient between naming responses in phases 1 and 2 was small but significant ($r = 0.32$, $P < 0.05$). In contrast to impaired performance on the picture naming task, YQS scored 100% correct in both phases of testing on the oral reading task. Using McNemar's test, performance on the oral reading task was found to be significantly better overall than performance on the picture naming task ($\chi^2 = 195.00$, $P < 0.0001$). These results show that, although YQS is unable to retrieve the names of many items from pictorial input, she is able to retrieve the same names from print without error.

Discussion

We have reported a Chinese patient who displays an enduring (though non-progressive) anomia accompanied

Table 3. Number of line drawings named correctly and number of words read correctly

	Picture naming	Oral reading
Session 1	130/233	233/233
Session 2	139/233	233/233
Overall	269/466	466/466

by intact oral reading of Chinese characters, including items that cannot be retrieved on a confrontation naming task. To the best of our knowledge, this is the first reported case of anomia without dyslexia in a Chinese speaker. The pattern of anomia without dyslexia in Chinese is precisely the opposite dissociation to preserved speech *with* dyslexia that was first reported by Lyman *et al.* (1938). Taken together, these two cases show that there is a double dissociation between spoken word production and oral reading in Chinese. This finding is incompatible with the notion that oral reading of Chinese characters must proceed from print to phonological output via semantic representations.

Our interpretation of the data in no way implies that normal oral reading cannot also proceed via the mappings between semantic representations and phonological output. To do so would ignore the large body of evidence that shows normal oral reading in Chinese to depend upon access to meaning (e.g. Perfetti *et al.*, 1992). We merely wish to claim that proficient oral reading in Chinese does not *require* access to the mappings between semantic representations and phonological output.

If proficient oral reading in Chinese does not require access to the mappings between semantic representations and output phonology, then how does YQS read aloud? We contend that YQS is reading solely via a non-semantic reading pathway that maps representations of orthographic units in Chinese such as radicals and characters directly onto phonological output. We have illustrated this 'direct' reading pathway on the right-hand side of the diagram shown in Fig. 4. We believe that this direct reading pathway is available to all skilled Chinese readers and that the data from YQS are the first to show there may be multiple pathways available to access phonological output from print in Chinese.

The diagram in Fig. 4 can account for all of the data we have collected from YQS. Recall from the case description that word–category assignment, picture–word matching and picture–picture matching are all well preserved for YQS, suggesting that there is no impairment to the semantic system, nor is there any impairment when accessing semantic representations from print. Moreover, phonological output is intact. However, we found that YQS has difficulty retrieving phonological output when given pictorial input, and that her category fluency is sparse. Both of these skills must depend upon access to the mappings between semantic representations and phonological output. We posit that YQS is unable to access the mappings between semantic representations and output phonology for YQS, and this is illustrated in Fig. 4 as a break in those connections.

Discussion of the data has so far made two crucial assumptions that are central to nearly all current models of picture and word processing (cf. Ellis and Young, 1988). First, we have assumed that pictorial and verbal input both contact a common set of semantic representations that are stored in a single semantic system. Second, we have assumed that there is a single output pathway that links these semantic representations with phonological output. An alternative account of picture naming and oral reading in Chinese is to argue that pictures and words contact separate semantic representations and that these representations contact phonological output independently, i.e. there is a pathway that connects pictorial–semantic representations with output phonology, and a pathway that connects verbal–semantic representations with output phonology (cf. McCarthy and Warrington, 1988). Although we acknowledge that this may turn out to be an accurate model of the semantic system in Chinese, we are unaware of any evidence to support a dissociation between visual–semantic and verbal–semantic systems at this time. However, if this evidence should emerge then the data from the present study would make only a very modest contribution to our conceptual understanding of oral reading in Chinese. This is because YQS could be impaired when accessing a pictorial–semantic system, yet also be unimpaired when accessing a verbal–semantic system. It would then follow that YQS could be reading via the semantic system and the mappings between the semantic system and phonological output.

We have also made the implicit assumption in Fig. 4 that radicals and characters are represented as independent orthographic units in the Chinese word recognition system, but that morphemes are not (see Fig. 4). We assume that radicals and characters must be represented, at the minimum, because many radicals have pronunciations that are different to the names of the whole characters that contain them. Also, Chinese surface dyslexic readers can retrieve the names of radical components even though they are unable to retrieve the names of the whole character that

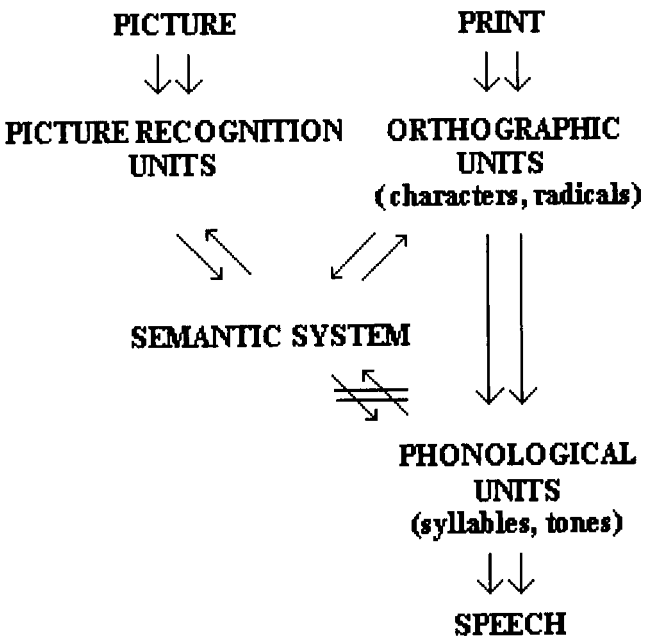

Fig. 4. Conceptual model of picture naming and oral reading in Chinese.

contains the radicals (Yin and Butterworth, 1992). It is possible that morphemes are also represented as independent units in the Chinese word recognition system. This is because the Chinese language contains compound words whose two morphemes (i.e. two characters) only ever occur in one 'binding word'. Thus, there are strong linguistic reasons to believe that morphemes are represented in the Chinese word recognition system. However, the data on this issue are equivocal (Taft and Zhu, 1995).

The present data show that the pattern of anomia without dyslexia is not restricted to alphabetic languages, nor to any one type of neuropathology. For example, Breen and Warrington (1995) reported an English patient with cerebrovascular disease, NOR, who displayed impaired confrontation naming with competent oral reading of words and non-words, good verbal comprehension and intact word repetition (see also Cipolotti and Warrington, 1995; Lambon-Ralph *et al.*, 1995; Schwartz *et al.*, 1980; Shallice *et al.*, 1983). Similarly, Sasanuma *et al.* (1992) reported three Japanese patients with DAT, who displayed a pattern of impaired confrontation naming and intact oral reading of Kanji characters.

The present study does not allow us to draw any firm conclusions regarding the issue of whether oral reading in Chinese can proceed *without access from print to semantic representations*, even though we have assumed that this is possible in Fig. 4. There are data showing that Kanji logographs can be read aloud without access to their meanings (cf. Sasanuma *et al.*, 1992). However, we concede that there is as yet no evidence to show that this is also true for Chinese logographs (recall that YQS is able to access semantic representations from print). We believe, however, that there may be neurological patients who can read Chinese characters aloud without access to their meanings and we are actively engaged in a research programme to find them.

In conclusion, the data from YQS add to the growing number of reports of Chinese aphasic patients whose aetiology and language profile are remarkably similar to their English-speaking counterparts (see for example April and Han, 1980; Bates *et al.*, 1991, 1993; Hu *et al.*, 1983, 1990; Naeser and Chan, 1980; Tzeng *et al.*, 1991; Yiu and Worrall, 1996). The present data show that there is much greater independence between confrontation naming and oral reading in Chinese than was previously believed in the literature (e.g. Hu *et al.*, 1983). Finally, the data demonstrate that normal oral reading of Chinese characters can proceed without access to the mappings between semantics and output phonology and may proceed via a non-semantic reading pathway that maps orthographic units directly onto phonological output.

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Anomia without dyslexia in Chinese

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Abstract

It is often assumed that oral reading of Chinese script proceeds from print to phonological output via semantic representations (e.g. Wang WS-Y. The Chinese language. Scientific American 1973; 228: 50–60). However, it is possible (at least in principle) that Chinese characters can be read aloud without access to the mappings between semantic representations and phonological output that are presumed to underlie normal spoken word production. We report the confrontation naming and oral reading performance of a Chinese anomic patient, YQS, whose word comprehension, word repetition and oral reading skills are intact. When her retrieval of names from pictures is compared with her retrieval of the same names from print, there is a highly significant advantage of oral reading over picture naming ($P < 0.0001$). Indeed, her oral reading of hundreds of Chinese characters is flawless. We argue that the data from YQS show that oral reading in Chinese does not require access to the mappings between semantic representations and phonological output, but instead can proceed via a non-semantic reading pathway that maps orthographic units, such as radicals and characters, directly onto phonological output.

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Primary diagnosis of interest

Anterior subcortical aphasia

Author's designation of case

YQS

Key theoretical issue

- Preserved oral reading co-incident with confrontation naming impairment
- Models of oral reading

Key words: anomia; dyslexia; oral reading; Chinese; subcortical aphasia; cross-linguistic studies

Author's designation of case

YQS

Scan, EEG and related measures

CT scan

Standardized assessment

Mini Mental State Examination (Chinese translation), Boston Naming Test (Chinese translation), Edinburgh Inventory-Reitan Dominance Scale (Chinese translation)

Other assessment

Naming line drawings, oral reading of Chinese characters, word–picture matching, picture–picture matching, spoken word repetition, writing Chinese characters, category fluency

Lesion location

- Basal ganglia
- Mild ventricular dilation in the left hemisphere

Lesion type

Cerebrovascular accident

Language

English