Selective grammatical-class deficits:

Implications for the representation of grammatical information in Chinese

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Abstract

The selective deficit of words that belong to certain grammatical classes (for example, nouns or verbs) as a result of brain damage are compelling discoveries and serve as a tool to uncover the representation of grammatical class information in the brain. In this area, the study of brain-damaged Chinese individuals provides special insights because Chinese nouns and verbs have unique linguistic features. In this chapter, relevant observations in literature and their theoretical implications on the representation of grammatical class information in Chinese words, including compound words, are reviewed.
1.1. Introduction

Grammar, the rules that allow infinite sentences to be built based on a finite set of words, is an essential component of languages. Although the question on the ways that the human brain represents and processes grammatical information has attracted the attention of philosophers and linguists for centuries, most psycholinguistic studies have focused on a specific class of single words. These are concrete nouns that have less consideration on the grammatical aspects of the vocabulary. How are grammatical properties of words in various classes captured by the cognitive/neural system? How does the brain “compute” the agreements (for example, case, tense, grammatical gender) between words so that grammatical sentences are produced to convey a message? How do language-specific linguistic factors affect the cognitive processes? Recent development of new techniques, such as neuroimaging (for example, Li, Jin, & Tan, 2004; Shapiro, Moo, & Caramazza, 2006; Tyler, Bright, Fletcher, & Stamatakis, 2004) have promoted some new ways of examining such theoretical questions. Nevertheless, the most consistent and revealing evidence is derived from the study of brain-damaged individuals.

Historically, the 1970s was revolutionary for its study of patterns in the break-downs induced by brain-damage, starting with alleged “agrammatic” speakers. Observations concluded that individuals with typical Broca’s aphasia, who produced speech with poor grammatical structure and made errors on grammatical morphemes, often also had difficulty
in comprehending sentences where grammatical structure interpretation was necessary. This evoked excitement among researchers and led to the proposal that there would be a functionally (possibly neurologically) independent “grammar module” shared by language production and comprehension and that it could be selectively impaired (see Caramazza, Berndt, Basili, & Koller, 1981). Although this was captivating, the hypothesis was soon proven wrong. Individuals with various profiles, such as those with only agrammatic speech, but intact comprehension, or with deficits in only one type of morphological morphemes, were reported (e.g., Bastiaanse, 1995; Miceli, Mazzucchi, Menn, & Goodglass, 1983; Nespoulous et al., 1988). Instead of trying to find a general mechanism that underlie brain-damaged individuals who are classified as a syndrome group with “grammatical impairment”, subsequent research has focused more on the understanding of the subcomponent organization in the grammatical system by looking at single cases with specific profiles. Among them, the representation of nouns and verbs has been one of the most fundamental issues of interest.

In this chapter, the intention is not to provide a complete review of the progress in understanding grammatical processes. Instead, the focus is on a distinctive type of individuals who show varied patterns of noun/verb dissociations. As well, the ways that the study of such patterns provides information on the representation of these two major grammatical categories in the brain will be discussed. In particular, there is an attempt to understand the
contrast between the Chinese language and Indo-European languages which might provide special insights on the issue. The chapter is organized into three sections. First, there will be a brief discussion on some specific properties in the Chinese grammar and the possible ways that such properties may affect cognitive processing. Then there will be a presentation on learnings about the grammatical system by studying speakers with noun/verb dissociations, especially Chinese ones. Finally, directions for future research will be disclosed.

1.2. Chinese grammatical system

Certain aspects of grammar are more likely to be universal across languages, such as the existence of a “noun” and a “verb” class. Nouns act as the objects or subjects in a sentence, while verbs act as their predicates. However, the detailed grammatical rules differ widely among languages. Packard (1993) conducted a comprehensive review on the specific characteristics of the Chinese grammatical system. Discussion for this paper will be limited to those that are potentially significant for cognitive theory building. A marked characteristic of the Chinese language is the paucity of inflectional morphology, which, by contrast, is very prevalent in Indo-European languages. For example, one Hungarian noun sometimes can take up to one hundred different inflectional forms. However, a Chinese word has only one form, regardless of the person, case, gender, tense or number attributes of the word. The consequences for the near absence of inflection in the cognitive system then become interesting. On the one hand, it is possible that the difference in the morphological processing
mechanisms that are associated with nouns and verbs in Indo-European languages (refer to detailed discussion in 1.3.3.) may not be visible in Chinese (refer to Shapiro & Caramazza, 2003). On the other hand, the paucity of explicit inflectional morphemes might not necessarily imply the absence of an abstract morpho-syntactic processing mechanism.

In Chinese, information such as aspect and case, is sometimes carried by various types of grammatical markers that are free-standing morphemes, such as classifiers, co-verbs, affixations, negative markers, aspect markers (see Law & Cheng, 2002). Some of them are specific for open-class words in a certain grammatical category. For instance, between a determiner and a noun, a classifier is obligatory. Prepositions were treated by Packard as co-verbs, given that they contained some attributes of verbs. Grammatical markers that are associated with verbs include aspect markers, which are used to express aspectual relations (过, /guo4/1, indicating the completion of the verbal action; 了, /le0/, indicating the completion of the verbal action or change of the sentence situation; 着, /zhe0/ or 在, /zai4/, indicating continuative aspect of verbal action).

The most productive morphological procedure in the formation of Chinese words is compounding. It is worth noting that the morphemes which comprise of the compound could originate from various grammatical classes. These might either be the same as the compound or different from it. For example, the word 火车 (/huo3che1/, train) is composed of two nominal morphemes 火 (/huo3/, fire) and 车 (/che1/, car), referred to as a “N=nn”
compound. The noun 讲台 (jiang3tai2, dais), on the other hand, consists of a verbal element 讲 (speak) and a nominal element 台 (platform) (N=vn). A verbal compound example is 跳水 (tiao4shui3, to dive), which contains a verbal element 跳 (jump) and a nominal element 水 (water) (V=vn). Therefore, the richness of internal word structures provides opportunities to study the grammatical aspects of word composition.

Finally, relative to other languages, the word order in Chinese is more flexible. Although the common word order is subject-verb-object (SVO), this order is often changed to a focus or emphasis on the object. Furthermore, some elements, such as noun phrases and pronouns, are more frequently omitted in Chinese than in other languages. These characteristics render the evaluation of “grammatical” deficits in a less straightforward way for language production in Chinese speakers. The approaches that are taken include: obtaining speech, generating norms of normal speakers and delegating of tasks with highly constrained grammatical components.

Whether such linguistic differences affect the cognitive system is theoretically significant. If this is the case, what is the importance? Packard (1993), based the analysis of one single case on an “agrammatic” Chinese case (Chen), comparing the “agrammatic” speech patterns in Chinese to the common profiles observed in Western language speakers. Similar to brain-damaged individuals of western languages, Chen’s speech showed short phrases, slow speech rate, syntactic simplification, function-word omission and
underemployment. However, in contrast to the frequent substitutions of functional morphemes that are observed in western individuals with aphasia, no substitution errors were observed for this Chinese agrammatic individual. The author argues that this difference is theoretically important because there are two potential origins for the substitution errors in alphabetic languages. These include deficits at the inflectional morphology system and deficits at selecting bound morphemes. Since Chinese has bound morphemes, but little inflectional morphology, the absence of substitution errors in the Chinese case indicates that the substitution errors in western languages might originate from the inflectional system. It is common knowledge that agrammatic individuals are not homogeneous and the patterns reported by Packard could either be due to the language difference or attributed to a particular case. However, his work inspires possible ways to address the issue.

Some researchers propose that the linguistic features of Chinese might also influence the acquisition pattern of nouns and verbs. While it has been widely reported that nouns are acquired earlier than verbs in many Indo-European languages (for example, Bornstein et al., 2004), Tardif and colleagues (Tardif, 1996; Tardif, Shatz, & Naigles, 1997; Tardif, Susan, & Fan, 1999) observed a reverse trend in Chinese children. These authors attributed such differences to a set of variables, including concept imageability, linguistic status as well as the parental speech input frequency. For instance, they observed that the early-acquired verbs by Chinese children had higher imageability than those by English-speaking children, leading
them to postulate that imageability affects verb-learning because actions with high imageability are more easily segmented and labeled. They also proposed that Mandarin verbs tend to occur at the end of utterances without complex morphological changes, making them easier for segmentation and learning. A further observation that might underlie the verb acquisition difference is that Chinese speaking mothers spoke more verbs to their children than English-speaking mothers.

Li et al. (2004) proposed that the paucity of inflectional morphology in Chinese may affect the ways that nouns and verbs are represented in the brain. Indeed, in a fMRI study where Chinese participants were asked to perform a lexical decision task on Chinese nouns and verbs, they failed to detect any difference in the neural activation between these two classes of words. This was different from the results with English speakers (e.g., Federmeier, Segal, Lombrozo, & Kutas, 2000; Shapiro et al., 2006; but see Tyler et al., 2004). One may argue that the lexical decision task used in their study was not sensitive to grammatical information and therefore, the null result should not be taken as evidence that Chinese nouns and verbs do not have distinguishable neural substrates. In the next section, several kinds of representations/processes in which nouns and verbs may differ and the possible ways that nouns and verbs as grammatical entities are represented in Chinese speakers will be discussed.

1.3. Selective noun-verb deficits
Mr. G. B. Vico (1688-1744) began the pursuit of noun/verb representation differences through seminal work which first described a brain-damaged male with selective impairment of verbs relative to nouns (see Denes & Barba, 1998). Subsequent researchers reported similar dissociations in both directions, including more severe impairment with verbs than nouns (for instance, Berndt, Haendiges, Mitchum, & Sandson, 1997; Berndt, Mitchum, Haendiges & Sandson, 1997; Breedin, Saffran, & Schwartz, 1998; Caramazza & Hillis, 1991; Hillis & Caramazza, 1995; Hillis, Wityk, Barker, & Caramazza, 2002; Kim & Thompson, 2000; Kohn, Lorch, & Pearson, 1989; Laiacona & Caramazza, 2004; McCarthy & Warrington, 1985; Miceli, Silveri, Nocentini, & Caramazza, 1988; Miceli, Silveri, Villa, & Caramazza, 1984; Rapp & Caramazza, 1998; Silveri & di Betta, 1997; Williams & Canter, 1997; Zingeser & Berndt, 1990) and more impairment with nouns than verbs (for example, Laiacona & Caramazza, 2004; Miceli et al., 1984, 1988; Rapp & Caramazza, 1997; Robinson, Rossor, & Cipolotti, 1999; Shapiro, Shelton, & Caramazza, 2000; Silveri & di Betta, 1997; Zingeser & Berndt, 1990).

The double dissociation between nouns and verbs has also been found in Chinese brain-damaged individuals. Bates, Chen, Tzeng, Li, and Opie (1991) conducted the first group study on Chinese speakers with noun/verb production by administering an oral picture naming task to two groups of subjects, individuals with Broca’s aphasia and those with Wernicke’s aphasia. They reported that the first group had more severe impairment in naming
verbs/actions than nouns/objects, but the latter presented the reverse. More recently, Bi, Han, Shu, and Caramazza (2005, 2007) conducted substantive investigation on a single case, ZBL, who had more difficulty in producing nouns orally in contrast to verbs.

Does the existence of such noun/verb dissociations indicate that the lexical representations of nouns and verbs are supported by different neural substrates and therefore, can be impaired selectively? This is not necessarily true. There are at least three levels of cognitive processing in which nouns and verbs may differ, including the conceptual, lexical and grammatical processing (for example, morpho-syntactic) systems (refer to a similar position in Bates et al., 1990; Shapiro & Caramazza, 2001, 2003; Laiacona & Caramazza, 2004). The grammatical dissociations observed in brain-damaged individuals were argued as attributable to any one or combination of these levels. In the following, the abilities and ways for the noun/verb grammatical distinction to play a role in each of these cognitive systems will be discussed.

1.3.1. Semantic/conceptual organization of nouns and verbs

The semantic/conceptual system is the cognitive component that is most unlikely to be affected by language-specific parameters (refer to Whorf, 1956). Therefore, if the noun/verb dissociation originates from the representation and/or processing difference in the conceptual system, it is likely to be universal among all languages, including Chinese. The school of semantic/conceptual accounts reduces the cause of noun-verb dissociation to a conceptual
basis. They claim that the grammatical-class effects in such dissociations are due to certain conceptual differences between nouns and verbs. These include concreteness/abstractness (Marshall, Chiat, Robson, & Pring, 1996; Marshall, Pring, Chiat, & Robson, 1996), imageability (Bird, Howard, & Franklin, 2000, 2001), semantic complexity (or specificity, Breedin et al., 1998), or semantic feature compositions (for example, Vigliocco, Vinson, Lewis, & Garrett, 2004; Vinson, Vigliocco, Cappa, & Siri, 2003). These accounts argue that verbs tend to be more abstract or have less-specific semantic representations than nouns. For example, the selective noun or verb deficits may arise from deficits in the semantic system itself, which is affected by concreteness and/or conceptual complexity. Grammatical specific deficits of some individuals can indeed be explained by these accounts (for example, Marshall, Chiat et al., 1996; Marshall, Pring et al., 1996; Berndt, Haendiges et al., 1997), but some speakers’ noun/verb dissociation persists even after the concreteness and imageability are matched between noun and verb stimuli.

The most prevailing conceptual theories are the object/action theory for the noun/verb dissociations. While nouns/verbs are terms addressing the grammatical dimensions, objects/actions are relevant in the conceptual system. Since noun/verb production is usually studied by using object and action naming tasks, there is confound between the noun/verb dimension and the object/action dimension. Therefore, the observed noun/verb dissociation might not be grammatical, but simply the disproportionate impairment of object or action
concepts, if it is assumed that the concepts of objects and actions in the semantic system are independently represented and can be selectively impaired (e.g., Damasio & Tranel, 1993; McCarthy & Warrington, 1985).1

There are recent theoretical accounts that specify in greater detail on the ways that the conceptual system is organized, such that nouns and verbs (objects and actions) can emerge as categories, such as the “extended sensory/functional theory” (ESFT, Bird et al., 2000, 2001) and the “featural and unitary semantic space” (FUSS) theory (for example, Vigliocco et al., 2004; Vinson et al., 2003). These theories assume that: conceptual knowledge is organized by distributed, modality-specific features (such as, sensory, functions, motoric, etc.); different categories of concepts (for instance, living things, artifacts, tools, body parts, actions) have different compositions of various types of features; the higher the proportion that a concept has of a certain feature type, the more “important” it becomes for the concept. Category-specific semantic deficit arises because of damage to one feature type, resulting in more severe impairment to the category in which that feature type is most important. For instance, in one specific model, Bird and colleagues (2000) assumed that the concepts of animate things (nouns), inanimate things (nouns), and actions (verbs) are represented by a gradual decreasing proportion of sensory features to functional features. As a result, damage to sensory features will affect animate nouns the most, inanimate nouns less and action verbs the least. Although there are reported cases that are consistent with this prediction (Bird et al.,
showing disproportionate noun (object) deficit and also animacy effect (better with animate things than inanimate things) within the object domain, there are also cases that contradict the prediction of this theory (see discussion in Laiacona & Caramazza, 2004).

Bi et al. (2005; 2007) reported a Chinese-speaking case, ZBL, who showed a pattern that was opposite to ESFT predictions. ZBL suffered two strokes, and a MRI scan revealed a lesion in the territory of the left posterior cerebral artery. It involved the occipital lobe and extended into the mesial surface of the left temporal lobe and laterally into the temporal occipital junction. During the testing sessions after the acute stage, he showed mild difficulty in visual and auditory comprehension tasks and more severe deficits in oral production tasks. His naming errors were not due to any peripheral motor impairment, but instead, were predominantly semantic errors. Significantly, he was better at naming verb/action pictures orally than in naming noun/object pictures ($\chi^2 (1) = 7.43, p < .01$) orally. Given that the object pictures and action pictures were matched on various factors including word surface frequency, word token frequency, number of syllables, name agreement, age of acquisition and familiarity ratings (see details in Bi et al., 2007), it is hard to argue that ZBL’s noun/verb (object/action) oral naming differences were due to variations in the difficulty level. An attribute judgment task, where ZBL was required to decide whether an attribute of a given thing was true or false (for instance, “a rooster has a short curly tail”), was used to examine ZBL’s conceptual knowledge. The results indicated that in comparison with the control group,
ZBL was impaired in attribute judgment for inanimate objects ($\chi^2(1) = 24.37, p < .0001$), but not for animate objects ($\chi^2(1) = 1.40, p = .24$). Furthermore, his performance on non-visual features was more likely to be better than his performance on visual features ($\chi^2(1) = 3.77, p = .05$). The difference was carried mainly by the inanimate objects (animate items: $\chi^2(1) = 1.26, p = .26$; inanimate items: $\chi^2(1) = 3.23, p = .07$). The reverse animacy effect (better performance in animate things than inanimate things) was also observed in an oral picture naming task to object pictures in a range of categories, again, after the control of various nuisance factors (lexical frequency and familiarity). The presence of the reverse-animacy effect and the disproportionate noun deficit compared with verbs for the same case, directly challenges the assumptions of ESFT.

The failure of one particular theory to account for the noun/verb (action/object) dissociation does not imply that noun and verb concepts do not differ in a systematic way. It is possible that the conceptual system is organized by modality-specific features and featural composition differences underlying noun/verb categories. The problem is the assumptions on deficit mechanisms. It is also possible that the assumptions on feature distributions should be modified (see Vigliocco et al., 2004; Vinson et al., 2003, for an alternative featural theory, FUSS). However, given the rich profiles of the brain-damaged cases with noun/verb dissociations that cannot be explained by existing conceptual theories, most likely, the grammatical class effects have other sources, such as the lexical and morpho-syntactic
processing.

1.3.2. Lexical organization of nouns and verbs

There is a line of evidence suggesting that the organization of the lexical system with regards to grammatical class distinction comes from cases with modality-specific grammatical deficits. Several cases have been reported to show the grammatical category-specific deficits in only one modality. For example, HW had selective difficulty in speaking verbs (oral picture naming and oral reading) and had intact ability in speaking nouns, writing both nouns and verbs (written picture naming and writing to dictation) (Caramazza & Hillis, 1991). Even when homonym pairs (for example, “the watch”/“to watch”) were used, he was impaired when speaking the verbs (‘to watch’), but not nouns (“the watch”). Given that HW was flawless in writing tasks, his semantic knowledge of concepts was intact and his verb deficits in oral production cannot be attributed to a semantic basis. Such modality-specific selective grammatical class deficits led researchers to propose that the organization of the lexical system includes a grammatical dimension such that verbs can be selectively impaired within the phonological (output) lexicon (see also Caramazza & Hillis, 1991; Hillis et al., 2002).

One might argue that the Chinese lexicon is less likely to be organized by grammatical categories because there is an abundance of homographs/homophones, the frequent nominal use of verbs, and the prevalence of compounds with morphemes of various grammatical types.
The observation of noun/verb dissociation at the lexical level in Chinese would be strong evidence that lexical distinctions are made along grammatical class dimensions. Indeed, there have not been any Chinese individuals documented with modality-specific selective noun or verb deficits until recently.

Han, Shu, Zhang, and Zhou (2005) presented a Chinese speaker with primary progressive aphasia, MPI, who suffered from the atrophy of left frontal and temporal lobes. He did not show significant noun/verb differences in visual comprehension (visual word-picture matching: nouns: 25/25; verbs: 22/25; $p = .23$) and oral word reading (nouns: 16/34; verbs: 11/34; $p = .22$). However, in written picture naming using the same well-matched stimulus sets that were mentioned earlier (see also Bi et al., 2005, 2007, for detailed information), he wrote nouns (18/34) better than verbs (6/34) ($\chi^2(1) = 9.27, p < .01$). Such a pattern was replicated using an independent set of stimuli where nouns and verbs were matched on word frequency, nouns: 43/100; verbs: 14/100; $\chi^2(1) = 20.63, p < .001$). He was equally impaired with nouns and verbs in auditory comprehension and oral naming. However, because his performance in these two modalities was at floor, it was not certain whether the noun/verb difference was selective to the written production modality.

In a recent preliminary study, a Chinese dysgraphic case, SJS, was observed to show a noun/verb dissociation only in written naming. He was a 57-year-old, right-handed male with a college education. He demonstrated a relatively preserved ability in a variety of lexical
comprehension and oral production tasks, including auditory word/picture matching (nouns: 25/25, correct; verbs: 24/25), visual word/picture matching (nouns: 25/25; verbs: 25/25) and oral picture naming (nouns: 31/34; verbs: 32/34). In contrast, he made frequent omission errors in written production tasks and showed more severe deficits for verbs than nouns, including written picture naming (nouns: 27/34; verbs: 17/34; \( p < .05 \)) and writing to dictation (nouns: 30/34; verbs: 20/34; \( p < .05 \)), using the same set of well matched noun/verb items that were tested on ZBL and MPJ. Such noun advantage in writing to dictation is not likely an attribute of sublexical mechanism because there is no grapheme-phoneme conversion in the writing of Chinese.

If one was to accept such modality-specific noun/verb difference as evidence for the existence of a grammatical dimension in the lexical system, how are compounds treated within such a lexical organization? As demonstrated in Section 1, Chinese compounds are quite often composed of morphemes from different grammatical classes, for example, 开关 (light-switch, open-close). Are words such as light-switch, represented in the noun “section” or in the verb “section”? Bates et al. (1991) argued that a straightforward distinction between a “verb lexicon” and a “noun lexicon” where compounds are treated as nouns and verbs by their composite class cannot be the full story. In their study, they found that Chinese-speaking individuals with Broca’s aphasia named verb/action pictures more worse than noun/object pictures. Individuals with Wernicke’s aphasia named noun/object pictures more worse than
verb/action pictures. Most interestingly, they observed that Broca’s individuals were significantly less likely to substitute the verbal element with another verb in V=vn compounds, while Wernicke’s individuals were less able to substitute the nominal element with another noun in the same compound words. Based on these findings, Bates and colleagues postulated that there is a “sublexical” level in which the grammatical category information also plays a role. Either the dissociation between verbs and nouns was due to the distinction of their sublexical level (nominal elements vs. verbal elements), or that dissociation could occur both at the word level and at the sublexical level. It was further observed that the effects of the sublexical components were mostly present in Wernicke’s individuals, but not in the ones with Broca. Under the assumption that the speakers with Wernicke’s aphasia had more conceptual impairment than speakers with Broca’s aphasia, the authors speculated that the distinction of nominal and verbal components in compounds had its roots in the semantic system.

However, subsequent studies failed to replicate the pattern described by Bates et al. (1991). For example, ZBL, who is described earlier with disproportionate noun deficits, was tested on three types of pictures. The picture names corresponded to Chinese two-character compounds, including V=vn (跳水, /tiao4shui3/, to dive), N=vn (讲台, /jiang3tai2/, dais), and N=nn (火车, /huo3che1/, train). Each type of words had 14 items. The items in the three types were matched on relevant variables including name agreement, concept agreement,
familiarity, word frequency and syllable frequency. The task was oral picture naming. ZBL was better at naming V=vn pictures than N=vn pictures ($\chi^2(1) = 5.859, p < .05$), although the two classes of words had the completely same sublexical structure. In contrast, he showed no difference between naming N=vn pictures and N=nn pictures ($\chi^2(1) < 1$) (see Figure 1). It seemed that only the grammatical class of the whole word, not the components, mattered. The same pattern was also observed in SJS, using this same set of stimuli, whose writing performance was affected by the grammatical class of the compound as a whole, but not its components (V=vn: 57% correct; N=vn: 79%; N=nn: 71%). As argued by Zhou, Ostrin, and Tyler (1993), it is possible that some compounds in Bates et al.’s study (1991) were actually phrases and the “sublexical” grammatical effects were lexical effects. It can also be argued that the lack of sublexical grammatical effect in ZBL and SJS were null results with the danger of Type II error. Further studies on the representation of compounds along grammatical class dimensions are necessary to resolve the issue.

Insert Figure 1 about here

1.3.3. Morpho-syntactic processing of nouns and verbs

The grammatical category has also been proposed as a dimension which syntactic processing and/or morphological processing of nouns and verbs operate along differently. First, it is possible that nouns and verbs play different roles in sentence construction and a syntactic processing deficit might affect one class of words more than the other. For instance,
it has been proposed that in comparison to nouns, verbs involve greater syntactic complexity in a sentence (see Zingeser & Berndt, 1990; Berndt, Haendiges et al., 1997, for discussion). In this case, when brain damage causes deficits of the representation and/or processing of syntactic knowledge, verbs will be more severely impaired than nouns. This syntactic account provides a reasonable interpretation of the origins for some verb specific deficits (for example, Kim & Thompson, 2000; Miceli et al., 1984), but it has inherent difficulty in accounting for noun specific deficits.

Morpho-syntactic accounts argue that some noun/verb dissociation of speakers in picture naming (or other single word naming) tasks can be due to the selective deficit of the morphological operation to one grammatical class. Evidence is derived from the association between picture naming deficit of one grammatical class and the deficit in carrying morphological operations for that class. For example, JR (Shapiro et al., 2000) had more difficulty in naming object pictures with nouns than in naming action pictures with verbs. When required to complete orally presented sentences with noun and verb homonyms that involved the addition/deletion of a nominal or verbal suffix (such as, “This is a guide; these are___”; “This person guides, these people___”), she was worse at producing nominal plural/singular forms than at producing verbal third-person singular/plural forms. The same pattern persisted even when pseudowords were used. For instance, JR was able to complete the sentence “This person wugs, these people___”, but not the sentence “These are wugs, this
is a ".” A reverse pattern was observed for the case of MR (Laiacona & Caramazza, 2004), who presented a selective deficit in processing verbal as opposed to nominal morphology. Based on these findings, it was proposed that morpho-syntactic operations for nouns and verbs can be selectively impaired and it is one of the causes for the noun/verb dissociation observed in the noun/verb (object/action) naming tasks. It seems that content words are always “inflected”, even when a single word is produced in “bare forms”.

Is it possible to explain the noun/verb dissociation of the Chinese brain-damaged speakers by the grammatical processing to one particular class? On the one hand, the rare occurrence of morphological inflection on word forms in Chinese could mean that there is no comparable mechanism to be selectively impaired and to cause noun/verb dissociation in single word naming. The noun/verb dissociations in Chinese can only be explained by the conceptual and lexical account. If Chinese individuals with noun/verb dissociation have intact conceptual knowledge in both classes of words (for example, SJS), then it becomes strong evidence for the theory that nouns and verbs are represented in the lexical system, such that they can be differentially affected.

Alternatively, it can be argued that the morpho-syntactic processes for different grammatical classes have some abstract and universal properties that can be realized differently in various languages. While it is reflected by morphological inflection in Indo-European languages, the morpho-syntactic process may underlie noun and verb
production by other means in Chinese, for instance, by the association with the grammatical markers that were introduced in Section 2. Information including aspects and numbers, can be expressed by certain grammatical markers, such as particles, classifiers, negative markers, etc. Some markers are related to nouns, such as determiners and classifiers, and some to verbs, such as negative markers and aspect markers. Law and Cheng (2002) developed a comprehensive “Cloze test” to examine the production of these different types of grammatical morphemes in Cantonese aphasia. A wide range of factors were investigated in the test, including aspect markers, negative markers, classifiers, pro-forms, coverbs, particles, and structural particles. They studied six fluent and four non-fluent Cantonese-speaking individuals with aphasia, along with five control participants. The participants were required to supply the missing elements of the sentences in highly constrained contexts. For example, to complete a sentence stimulus “daidai hai naamtsai; muimui___hai naamtsai” (the brother is a boy; the sister___a boy”), a negative marker “m” is required “daidai hai naamtsai; muimui m hai naamtsai” (the brother is a boy; the sister isn’t a boy”). They compared the relative accessibility of different grammatical morphemes between different aphasia types. The results revealed a tendency for better performances in the individuals with fluent aphasia for various morpheme types, relative to the speakers with non-fluent aphasia. However the difference between the two groups was quantitative rather than qualitative. This is not surprising because it is now known that these “syndrome” groups are not homogeneous and
standardizing cases with different underlying deficit mechanism can be misleading.

It is proposed that further investigation along this line is to study whether grammatical markers of one particular type can be selectively impaired by brain damage and the relationship between such categorical effects and the grammatical class effect in single word production. For instance, if a brain-damaged individual is observed to have more difficulty in producing verbs (action names) than producing nouns (object names) in picture naming or other naming tasks, the question that may be asked is whether she or he also shows a selective deficit in producing grammatical markers for verbs, for example, aspect markers and coverbs, compared to nominal grammatical markers, such as classifiers. It is known that individuals showing noun/verb dissociation do not necessarily show dissociation between nominal markers and verbal markers at the same time, given that some noun/verb dissociation may have a conceptual cause. However, it is an open issue whether a speaker with a selective deficit in grammatical markers of one class will also show more severe difficulty in single content-word production in the corresponding category. If such association is prevalent, it would be evidence that is consistent with the view that morpho-syntactic processes are universal and sensitive to grammatical classes. However, if cases are observed that have selective impairment to grammatical markers of one grammatical class, but intact single word production, they would suggest that lexical retrieval of content words and the corresponding grammatical markers are rather independent. It would also mean that the grammatical effects
for single word naming in Chinese are not readily explained by some of the grammatical class effect in the morpho-syntactic processes.

1.4. Future directions

It has been argued that the selective deficits to one grammatical class of words (nouns or verbs) displayed by individuals with brain damage offer an opportunity to study the representation and processing of grammatical knowledge in the brain. With the understanding that there are heterogeneous causes for such dissociations, the following lines are proposed for future research.

To isolate the different sources of noun/verb dissociation, the focus should be more on single cases, using tasks and test stimuli with more dimensions of manipulation. For example, using the materials of abstract nouns and verbs helps discriminate the conceptual explanation from others. Also, cross-linguistic comparisons would be particularly informative in unveiling the core, universal aspects of grammatical processing. In this context, it is crucial to integrate multiple research methods, including the cognitive neuropsychological approach with brain-damaged individuals, functional imaging and behavioral techniques with normal subjects.

Instead of finding a unified reason for the observed noun/verb dissociation in clinical settings, the goal for this line of pursuit is to answer the following questions: How is the knowledge of a word being a noun or a verb represented and processed in the brain? How is
conceptual knowledge organized? How are lexical knowledge and grammatical operations integrated together? In other words, how does the brain know that a noun is a noun and use it as a noun?
References


Footnotes

1. The pinyin system is used for phonetic transcription of Chinese characters. The number represents the tone of the syllable preceding it. There are five tones in Mandarin Chinese, level (1), rise (2), fall-rise (3), fall (4), and unstressed (0).

2. Whenever we cannot distinguish these two dimensions, we acknowledge such confound by using these two sets of terms interchangeably. The major limitation of this explanation is that it is unspecified on the presentation manner of abstract nouns and abstract verbs (see Laiacona & Caramazza, 2004).
Figure 1. ZBL’s performance as a function of grammatical word class in oral picture naming