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Representation of Polysemy in Mandarin Verbs: *Chī*, *Dǎ*, and *Xǐ*[*]

Huichen S. Hsiao, Yi-Chun Chen & Ying-Chen Wu
National Taiwan Normal University

This paper reports the findings from a semantic judgment priming task aimed at examining how senses of three semantically complex Mandarin verbs *chī* 'eat', *dǎ* 'hit', and *xǐ* 'wash' are stored in the mental lexicon. In the experiment, the prime stimuli belonged to the basic senses of the three critical polysemous verbs. Three target conditions, that is, verb phrases with the same basic senses (e.g. *chī niúpái* 'to eat steak'), closely related senses (e.g. *chī wěiyá* 'to attend a year-end party'), and distantly related senses (e.g. *chī lǎoběn* 'to live on one's own fat'), were prepared to test whether processing patterns varied for different types of extended senses within a polysemous verb. The results indicate linearly decreasing priming effects for senses moving from the core senses, through closely related senses, to distantly related senses. These effects conflict with the separate-entry view and provide evidence for a shared core representation among polysemous senses.

Key words: lexical ambiguity, polysemy, semantic priming, sense relatedness

1. Introduction

How words are acquired, stored, and recollected in the mind remains a topic of extensive research. Although physical dictionaries and the mental lexicon may be assumed to be accessed dissimilarly, their actual physical differences and the implications of such differences continue to arouse scholars' interest. Although previous studies on the mental lexicon have addressed the initiation time of word recognition (Marslen-Wilson 1975), the effect of frequency on word recognition (Savin 1963, Forster & Chambers 1973, Whaley 1978), and the processing of morphological information in English (Taft & Forster 1975, Marslen-Wilson et al. 1994) and compound words in Mandarin (Zhou & Marslen-Wilson 1994, 1995), others have highlighted the topic of lexical ambiguity. Although much effort has been devoted to discussing the distinction between polysemy and homonymy in the mental lexicon, questions remain as to how polysemous words with various extensions are represented in the mind. Thus, the present study investigated one type of ambiguity, namely polysemy, probing the representation of various senses of a semantically complex polysemous word.

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1.1 Representation of lexical ambiguity

Ambiguity occurs when a word possesses multiple meanings, causing various interpretations of the word without presence of sufficient contextual clues. Regarding the types of ambiguity, ambiguous words can be further divided into two groups: *homonymy*, in which two unrelated meanings coincidentally share the same orthography and phonology (e.g. *bank* [river bank vs. commercial bank]), and *polysemy*, in which a single lexical form carries more than one etymologically or semantically related sense (e.g. *foot* [lower extremity of the body vs. bottom part of a mountain]) (Lyons 1977, Tuggy 1993, Rodd, Gaskell & Marslen-Wilson 2002, Baretta, Fiorentino & Poeppel 2005). One of the key questions concerning lexical ambiguity is whether ambiguous words are processed distinctly. Several experiments have been conducted to measure the effects of ambiguity in lexical decision tasks (e.g. Jastrzembski 1981, Hino, Kusunose & Lupker 2010, Lin & Ahrens 2010). Their findings support the view that ambiguity is advantageous, that is, that words with numerous meanings facilitate the speed of lexical access compared with unambiguous words or words with fewer meanings.

Although these studies have postulated that ambiguity is advantageous, other researchers have questioned the decisive effect of the number of meanings of a word (NOM), claiming that relatedness may be a more crucial factor in lexical access (Azuma & Van Orden 1997, Rodd, Gaskell & Marslen-Wilson 2002). In the study by Azuma & Van Orden (1997), two lexical decision tasks indicated that relatedness among meanings, rather than NOM, may be a more valid factor affecting lexical decision performance. Similar results were reported by Rodd, Gaskell & Marslen-Wilson (2002) regarding both visual and auditory lexical decision tasks, in which an advantage from words with numerous senses (related semantic representations) and a disadvantage from words with numerous meanings (unrelated semantic representations) during lexical decision were observed.[1]

The findings of Azuma & Van Orden (1997) and Rodd, Gaskell & Marslen-Wilson (2002) suggest a distinction between homonymy and polysemy during lexical access, illuminating how polysemous senses may be represented in the mental lexicon, a topic long debated by scholars. There have been two accounts of how different senses of a polysemous word are stored in the mind. The *separate-entry view* maintains that each polysemous sense is represented individually, similar to homonymous meanings, and that even though polysemous senses are semantically

[1] An alternative hybrid approach to polysemy is proposed by Tuggy (1993), who developed a cognitive model in which both information about the core (schema) and the different senses are represented. This model is based on the Langacker's (1987) Cognitive Grammar Framework.

related, this linguistic connection is not psychologically real, or at least exerts a minimal effect (Klein & Murphy 2001, 2002). Klein & Murphy (2001) examined whether the processing of polysemy and homonymy differs. In their first experiment, subjects first studied a list of phrases using different senses of polysemous words. After this learning phase, they performed a recognition memory task in which they indicated whether they had seen the same word during the learning phase. The researchers reasoned that if polysemous senses are stored in separate entries, then words that are used in the same sense would be more accessible than when they are used in another sense; however, if there is a core representation, then subjects would access that meaning, and the performance between the same and different sense conditions would not differ. The results not only showed that consistent senses are evaluated more accurately, but also that the accuracy rate for the response of inconsistent senses is no better than chance. This supports the separate-entry view. In their second and third experiments, subjects judged the sensicality of pairs of phrases. These included consistent phrasal pairs (e.g. *wrapping paper* as prime, *shredding paper* as target) and inconsistent phrasal pairs (e.g. *wrapping paper* as prime, *liberal paper* as target). The results revealed that the size of the consistency effect exerted by homonymous pairs and polysemous pairs did not differ, supporting the claim that even related polysemous senses are separately represented, and that semantic overlap for polysemous senses exerts a minimal effect.

In another study, Klein & Murphy (2002) applied three forced-choice sorting tasks to determine whether the different senses of a polysemous word are perceived to be in the same category. In these tasks, the subjects were presented with a target phrase containing a polysemous word in one of its senses (e.g. *wrapping PAPER*). Two phrases were presented below the target phrase: one phrase with the same polysemous word but with either a different sense or the same sense (e.g. *liberal PAPER*), and one phrase with another word that was taxonomically linked to the target polysemous sense (e.g. *smooth CLOTH*). From the two phrases, the subjects were asked to choose the phrase that most appropriately matched the target phrase. The results found that in less than 20% of the trials, the polysemous sense was chosen; this rate was significantly lower than the same word condition and the alternate choices (e.g. taxonomic or thematic categories). The same results were obtained when the subjects were primed with paragraphs that contained parallel senses. Klein & Murphy (2002) concluded that polysemous senses share either minimal or no core meaning. Polysemous senses are thus represented separately, similar to homonymous meanings.

The *core-meaning view* proposes that a core semantic representation is shared by the senses of a polysemous word and that the individual senses are activated pragmatically (Caramazza & Grober 1976, Nunberg 1979). According to this view, homonymy

and polysemy are processed differently because polysemous senses are extended from one core meaning, thereby sharing a certain representation, whereas homonymous meanings are represented separately because of unrelatedness between the meanings.

The core-meaning view has been supported by numerous studies. Off-line relatedness rating and saliency rating tasks conducted by Durkin & Manning (1989) revealed that homonyms are processed differently than polysemes (distinct senses of the same word) and that the dominant sense of a polysemous word is most likely to be rated as critical, even when the context is unbiased toward it. A similar phenomenon was observed in a priming task and semantic judgment task performed by Williams (1992) who found that the core sense was facilitated one second after the prime onset whereas the subordinate sense did not exert such an effect. He concluded that this may be explained in terms of the frequency or structural hierarchy of senses in words because accessing dominant senses might partly entail accessing the subordinate senses. In their eye-movement experiment, Fraizer & Rayner (1990) found that when disambiguating contexts were presented after an ambiguous word, words with multiple meanings (homonyms) were fixated on longer than were words with multiple senses (polysemes). Using magnetoencephalography (MEG) recordings in a visual lexical decision task and a sensicality judgment task, Beretta, Fiorentino & Poeppel (2005) and Pylkkänen, Llinás & Murphy (2006) discovered differing neurological patterns for homonyms and polysemes. In a study by Beretta, Fiorentino & Poeppel (2005), not only did the lexical decision times for the two types of ambiguity differ, but the latency of the M350 component was shorter for polysemes compared with homonyms. Pylkkänen, Llinás & Murphy (2006) observed no differences between homonymy and polysemy in a sensicality judgment task, a finding consistent with the prediction of the separate-entry view. However, there was a homonym delay in the left hemisphere M350 data, which suggests deactivation of the rival meaning, and such lengthened peak latencies were not observed for polysemy. In addition, there were longer latencies for polysemous targets in the right hemisphere sources while homonyms did not elicit such an effect. In summary, the results of Beretta, Fiorentino & Poeppel (2005) and Pylkkänen, Llinás & Murphy (2006) counter the theory that polysemous senses are processed as individual entries, further supporting the core-meaning view.

1.2 Processing polysemous senses and their representations

Although most studies supporting the core-meaning view have investigated the processing of polysemy and homonymy, other studies have explored how various types of polysemous senses are represented in the human mind. Klepousniotou (2002)

used a cross-modal sentence-priming lexical decision task to observe differences in lexical processing among polysemes with dissimilar extension rules. Four types of ambiguous words were used: homonymous words, polysemous words with metaphorical extensions, polysemous words with a count/mass metonymic extension, and polysemous words with a producer/product metonymic extension. The results of the priming experiments revealed that metonymic polysemes exerted greater priming effects than metaphoric polysemes and homonyms did Klepousniotou contends that the senses of a metonymic word share a single representation in the mental lexicon and that a homonymous word has a representation for each meaning. Metaphoric polysemes, by contrast, are said to be in a transition state between generated senses and separately stored meanings. The processing differences between metonymic and metaphoric polysemes have been further evidenced in audio and visual lexical decision tasks (Klepousniotou & Baum 2007) and in an electroencephalograph experiment (Klepousniotou et al. 2012). In particular, Klepousniotou et al. (2012) observed a graded effect in metaphorically extended senses, whereas the effects were proportionate for the two senses of a metonymical polysemy. The researchers explained that metaphorically extended senses are rather atypical because of their unpredictable referents. Therefore, the processing of metaphorical senses is not similar to that of metonymy or homonymy.

In contrast, Brown (2008) used a sensicality priming test to investigate the effect of sense relatedness in lexical processing. According to dictionary definitions and ratings of relatedness by 20 native speakers, verb phrase stimuli were divided into four conditions: those having an unrelated sense, those having a distantly related sense, those having a closely related sense and those having the same sense. Each condition contained 11 pairs (e.g. “cleaned the shirt/cleaned the cup” for the same sense condition, “banked the plane/banked the money” for the unrelated condition). The results demonstrated that the priming effect was strongest when the prime and target verb phrase stimuli shared the same verb sense and weakest for stimuli constructed of homonymous verbs. A linear progression from unrelated senses, through distantly related senses and closely related senses to the same senses was observed. This supports the core-meaning view, and the linear progression may suggest a hierarchy of sense distinction similar to the hierarchy Williams (1992) mentioned; that is, the activation degree of the senses depends on how central those senses are to the core representation. Another explanation for the linear progression is that the representations within a polysemous word overlap, sharing a general semantic space (Brown 2008).

In summary, previous researchers have applied various experimental paradigms and materials to explore the lexical activation process for ambiguous words.

Nevertheless, there is no model which explains how meanings and senses are represented. Polysemy, in particular, requires more extensive investigation because the sense extension of a polysemous word is more complex than that of a homonym. In the studies reviewed, the materials chosen relate mostly to polysemous words possessing only two senses (e.g. Durkin & Manning 1989, Williams 1992, Klepousniotou 2002, Brown 2008). Thus, the conclusions of such studies have merely explained how the two senses of a certain type of polysemy (e.g. metonymically extended sense) may appear in the mental lexicon. However, Mandarin consists of numerous polysemous words with various senses derived from more than one type of extension principle (cf. Appendix).[2] For instance, according to Chinese WordNet, *chī* 'to eat' has 28 senses, *dǎ* 'to hit' has 121 senses, and *xǐ* 'to wash' has 7 senses. We wonder whether the representation of these semantically complicated polysemous words with various extended senses, including metonymic and metaphorical senses, can be explained using the models reviewed. Such semantically complicated words require more attention and investigation, which provides a suitable opportunity for reexamining accounts of polysemic representation. Therefore, the present study focused on three semantically rich polysemous verbs, *chī*, *dǎ*, and *xǐ*, and their nuanced senses to investigate the distinctive semantic processing patterns and the psychological representation of their various senses.

2. Research questions

The present study used a semantic judgment priming task to investigate whether the various senses of the verbs *chī*, *dǎ*, and *xǐ* are accessed and stored differently in the mental lexicon. The research questions were twofold: (1) Does the degree of sense relatedness and the degree of familiarity with a verb phrase affect semantic processing time? (2) Are polysemous senses stored separately or do they share a core meaning or general representation?

The separate-entry view maintains that dissimilar senses of a polysemous word are stored separately, with no semantic overlap between each pair of polysemous senses (e.g. Klein & Murphy 2001). This view would be consistent with the prediction that the degree of sense relatedness results in no difference in semantic processing time; thus, processing closely related senses of a word would be as slow as processing distantly related senses. An extreme core-meaning view contends that only the core meaning is stored in the mental lexicon. Therefore, similar processing patterns may be

[2] For discussions concerning the lexical representation and activation of modern Chinese compound words, please refer to Zhou & Marslen-Wilson (2000a, 2000b).

assumed for the basic senses, closely related senses, and distantly related senses because the specific senses are all generated online. However, weaker views, which support the existence of a core semantic representation shared by polysemous senses, acknowledge subtle semantic features within each sense that aid in distinguishing one sense from another (Klein & Murphy 2001). These views would predict varying priming effects for dissimilar conditions depending on the size of area overlap: Processing the same basic senses would be faster than processing closely related senses, and processing closely related senses would be faster than processing distantly related senses.

3. Experiment

3.1 Participants

A total of 38 native speakers of Mandarin (18 women, 20 men), with an average age of 26 years (range: 19–40), participated in a semantic judgment task and a post hoc questionnaire concerning the familiarity of stimuli in a priming task. All participants had received at least 15 years of education and reported Mandarin as their main language (accounting for more than 70% of daily use).

3.2 Materials

All the materials selected for the semantic judgment priming task were verb phrases comprising a verb and a disyllabic noun; thus, three characters constituted each verb phrase.[3] For each polysemous verb, 9 prime verb phrases and 18 target verb phrases were used. All prime phrases were constructed using the basic sense of each verb. Regarding the target materials, three stimuli conditions were prepared for each verb: (1) same basic senses, (2) closely related senses, and (3) distantly related senses. Each condition consisted of six verb phrases. In summary, for each verb, 15 stimuli with a basic sense, 6 stimuli with a closely related sense, and 6 stimuli with a distantly related sense were employed. These stimuli comprised 27 primes and 54 targets in total (See Table 1 for examples and the Appendix for a full list of primes and targets, as well as a list of filler materials).

[3] For example, in *chī shǔtiáo* 'to eat French fries', *chī* is the verb 'to eat,' whereas *shǔtiáo* is the disyllabic noun 'French fries.' Although polysemy can be easily identified in English, in our experiment, the chosen polysemous verbs were more nuanced because of a complex wordhood concern (Myers 2006). Therefore, we paired a disyllabic noun after each verb to ensure that the polysemous senses of the verbs were salient. For a more detailed discussion on wordhood and on what is listed in the Chinese mental lexicon, please refer to Myers (2006) and Packard (2000).

Table 1. Examples of the stimuli

Verbs / Conditions	*chī*	*dǎ*	*xǐ*
	Primes		
	chī niúpái (eat, steak) 'to eat steak'	*dǎ huàirén* (hit, bad guy) 'to hit a bad guy'	*xǐ wàzi* (wash, sock) 'to wash socks'
	Targets		
Same senses Basic sense + basic sense	*chī tángguǒ* (eat, candy) 'to eat candies'	*dǎ xiǎohái* (hit, kid) 'to hit kids'	*xǐ guōzi* (wash, pot) 'to wash pots'
Closely related senses Basic sense + closely related sense	*chī wěiyá* (eat, year-end party) 'to attend a year-end party'	*dǎ páiqiú* (hit, volleyball) 'to play volleyball'	*xǐ wēnquán* (wash, hot spring) 'to bathe in a hot spring'
Distantly related senses Basic sense + distantly related sense	*chī bàizhàng* (eat, lost battle) 'to lose a battle'	*dǎ cǎogǎo* (hit, draft) 'to write a draft'	*xǐ yuānqū* (wash, injustice) 'to right a wrong'

A pool of 203 verb phrases (e.g. verbs with disyllabic noun phrases) for *chī* (n = 63), *dǎ* (n = 94), and *xǐ* (n = 46) were collected from the Sinica Corpus Chinese Word Sketch[4] and Google Search. The senses of each verb-noun combination were identified for further classification. The categorization relied on two established criteria: (1) the senses of the verbs were listed in the *Revised Mandarin Chinese Dictionary*, Chinese WordNet (Huang & Hsieh 2010), and previous studies on the semantic analysis of the selected verbs (e.g. Jiang 1989, Tao 2000, Chen 2012, Hsiao 2013); and (2) the stimuli had to be sorted into the same category by three native Mandarin speakers who had received Chinese linguistic training.

3.2.1 Basic senses

A verb phrase was identified as having the basic verb sense if the sense was found in the *Revised Mandarin Chinese Dictionary* (Ministry of Education, R.O.C. 1994) and listed as the first entry in Chinese WordNet. All the verb phrases which satisfied these two requirements consisted of a verb-object (VO) construction. The basic senses for each selected polysemous verb are as follows:

[4] http://wordsketch.ling.sinica.edu.tw/

Table 2. Basic senses adopted in this study

Verbs	Basic sense
chī	to swallow food through the mouth (to eat) (Huang & Hsieh 2010)
dǎ	to hit a certain object with the hand or with an instrument held in the hand (to hit) (Huang & Hsieh 2010)
xǐ	to clean off the dirt with water or cleaner (to wash) (Huang & Hsieh 2010)

3.2.2 Closely related senses

A verb phrase was categorized as a closely related sense when (1) the usage of the verb has been considered an extended sense by previous semantic analyses, or (2) if the usage is categorized by the Chinese WordNet as a different sense from the basic one in the same entry (Table 3).

Chī and *xǐ* can be followed by atypical nouns indicating a location (e.g. *chī wěiyá* 'to attend a year-end party', *xǐ wēnquán* 'to bathe in a hot spring', *xǐ rèshuǐ* 'to take a hot shower') or similar manners of the action their basic sense denotes (e.g. *chī nǎizuǐ* 'to suck on a pacifier') (Tao 2000, Hsiao 2013). These metonymic senses were categorized into the closely related sense. Other verb phrases were sorted into this condition after referring to Chinese WordNet (Huang & Hsieh 2010), in which extended senses are listed under an entry's basic sense. Although differing from the basic senses, the verb senses in this condition are "concrete" extended senses implying physical actions. For instance, *chī nǎizuǐ* 'to suck on a pacifier' entails the action of placing an item in the mouth and sucking; however, the sense of *chī* here differs from the basic sense in that there is no swallowing process. *Dǎ yǔqiú* 'to play badminton' entails a hitting movement; similarly, *xǐ zhàopiàn* 'to develop photos' includes a rinsing process.

3.2.3 Distantly related senses

A verb phrase was categorized into the condition distantly related sense when the verb usage had been identified as an extended sense in previous verb semantics studies. Such senses, unlike the closely related senses, extend further from the basic sense because they are more abstract and involve no physical action.

Chī in these VO constructions can be extended to "to live off (somebody/something)" and "to suffer" (Jiang 1989, Tao 2000). For these extensions, the senses of *chī* have been extended from the domain of action and behavior to the domain of psychology (Chen 2012). In the process of stimuli selection, *chī* verb phrases that conform to

Table 3. Closely related senses in this study

Verbs	Closely related senses
chī	• Sense: to eat at a certain location (Huang & Hsieh 2010) *chī xǐjiǔ* (eat, wedding feast) 'to attend a wedding feast' *chī mósī* (eat, Mos Burger) 'to eat at Mos Burger (a burger chain)' *chī wěiyá* (eat, year-end party) 'to attend a year-end party' • Sense: to chew the following object to suck its nutrition (Huang & Hsieh 2010) *chī gānzhè* (eat, sugarcane) 'to chew sugarcane' *chī bīnláng* (eat, areca nut) 'to chew areca nut' • Sense: to keep an object in the mouth and chew it as a subconscious habit (Huang & Hsieh 2010) *chī nǎizuǐ* (eat, pacifier) 'to suck on a pacifier'
dǎ	• Sense: to play percussion instruments by rapidly striking the surface of an object with the tips of arm-like artificial objects (Huang & Hsieh 2010) *dǎ dàgǔ* (hit, bass drum) 'to play the bass drum' *dǎ xiǎngbǎn* (hit, castanets) 'to play the castanets' *dǎ mùqín* (hit, xylophone) 'to play the xylophone' • Sense: to play ball games (Huang & Hsieh 2010) *dǎ páiqiú* (hit, volleyball) 'to play volleyball' *dǎ yǔqiú* (hit, badminton) 'to play badminton' *dǎ lánqiú* (hit, basketball) 'to play basketball'
xǐ	• Extension principle: *xǐ* + atypical noun (to wash or clean at a certain location or in a certain manner) (Hsiao 2013) *xǐ rèshuǐ* (wash, hot water) 'to take a hot shower' *xǐ lěngquán* (wash, cold spring) 'to bathe in a cold spring' *xǐ wēnquán* (wash, hot spring) 'to bathe in a hot spring' *xǐ pényù* (wash, tub) 'to bathe in a tub' *xǐ lěngshuǐ* (wash, cold water) 'to take a cold shower' • Sense: to develop exposed films with a certain solution (Huang & Hsieh 2010) *xǐ zhàopiàn* (wash, photo) 'to develop photos'

the aforementioned semantic extensions were categorized into the distantly related sense condition (e.g. *chī lǎoběn* 'to rest on one's laurels' and *chī kǔtou* 'to suffer from hardship').

Under the prototypical concept of *xǐ* (CHANGE [an object]), the basic sense could

Table 4. Distantly related senses

Verbs	Distantly related senses
chī	• Sense: to suffer (Ministry of Education, R.O.C., 1994) *chī guānsī* (eat, lawsuit) 'to be sued' *chī kǔtou* (eat, hardship) 'to suffer from hardship' *chī bàizhàng* (eat, lost battle) 'to lose a battle' *chī mènkuī* (eat, silent, lost) 'to be compelled to suffer in silence' • Sense: to live off (somebody/something) (Tao 2000) *chī lǎoběn* (eat, original capital) 'to rest on one's laurels' *chī zìjǐ* (eat, oneself) 'to depend on oneself'
dǎ	• Sense: to plan, to determine (Ministry of Education, R.O.C. 1994) *dǎ zhǔyì* (hit, idea) 'to plan a scheme' *dǎ cǎogǎo* (hit, draft) 'to prepare a draft' • Sense: to apply (Ministry of Education, R.O.C. 1994) *dǎ bǐyù* (hit, rhetorical comparison) 'to make a rhetorical comparison' *dǎ guānqiāng* (hit, bureaucratic tone) 'to speak in a bureaucratic tone' • Sense: to interact with people (Ministry of Education, R.O.C. 1994) *dǎ jiāodào* (hit, principles for communication) 'to have dealings with someone' *dǎ zhàomiàn* (hit, encounter) 'to come face to face with someone'
xǐ	• Extension principle I[5] *xǐ yuānqū* (wash, injustice) 'to right a wrong' *xǐ qiánchǐ* (wash, previous humiliation) 'to expunge previous humiliation' *xǐ zuìzhàng* (wash, sin) 'to eliminate sin' • Extension principle II *xǐ hēiqián* (wash, corrupt money) 'to launder money' *xǐ guójí* (wash, nationality) 'to change nationality for a higher social status' *xǐ xuélì* (wash, academic history) 'to hide an unsatisfactory academic history by studying at a more prestigious educational institution'

be extended to mean "to change from the state of being illegal (bad) or containing something to the state of being legal (good) or empty" (Hsiao 2013). We included phrases from our collected data in this category if they contained these extended senses (e.g. *xǐ hēiqián* 'to launder money', *xǐ qiánchǐ* 'to expunge previous humiliation').

[5] The extension principle I is "TO WASH IS TO CHANGE FROM THE STATE OF HAVING SOMETHING TO THE STATE OF BEING ALMOST EMPTY", while the extension principle II is "TO WASH IS TO CHANGE FROM THE STATE OF BEING ILLEGAL (BAD) TO THE STATE OF BEING LEGAL (GOOD)", (cf. Hsiao 2013).

Because few studies pertaining to the verb *dǎ* have addressed the semantic extension of its numerous senses, we grouped verb phrases that contain the senses listed in the *Revised Mandarin Chinese Dictionary* (Ministry of Education, R.O.C. 1994) and are listed under the same entry as the basic sense "hit" but have an extended meaning in Chinese WordNet (Huang & Hsieh 2010) into the distantly related sense condition (e.g. *dǎ zhǔyì* 'to plan a scheme').

The verb senses in the distantly related sense condition have undergone abstraction and are followed by nonconcrete nouns, such as *bǐyù* 'rhetorical comparison', forming verb phrases that are less transparent than those in the previous two conditions (e.g. *dǎ bǐyù* 'to plan a scheme'). All senses in this condition were derived from metaphorical semantic extensions enabling the verbs to be paired with nouns from other domains.

A set of filler stimuli were designed in addition to the critical stimuli mentioned previously (see the Appendix). The filler stimuli comprised 27 pairs of prime verb phrases and target verb phrases with the same verb, nine pairs starting with each of the three polysemous verbs. Of the 27 filler pairs, nine pairs consisted of nonsense prime phrases (e.g. **xǐ chēzhàn* 'to wash a bus or train station') and nonsense target phrases (e.g. **xǐ rènào* 'to wash bustle'), nine pairs consisted of semantically coherent prime phrases (e.g. *chī zǎofàn* 'to eat breakfast') and nonsense target phrases, and nine pairs consisted of nonsense target phrases and semantically coherent prime phrases.[6]

3.3 Procedure

The participants were tested individually. They all reviewed the 81 pairs of stimulus items, including 27 pairs of fillers. Because only nine prime stimuli for each verb were created, each prime stimulus was presented twice during testing. The stimulus items were randomized during the testing but were controlled to ensure that every two consecutive pairs of prime and target phrases contained different polysemous verbs.

Testing was conducted using the E-Prime 2.0 program (Psychology Software Tools, Pittsburgh, PA) for stimulus presentation. During the semantic priming task, subjects viewed the stimuli and indicated whether the stimuli were reasonable by pressing buttons corresponding to the answer *yes* or *no*. The participants were asked to react as quickly and accurately as possible to both prime verb phrases (involving

[6] According to the process of stimulus selection, the number of verb-noun combinations for each sense was extremely hard to control, resulting in imbalanced numbers of senses and stimuli among verbs. An analysis pertaining to this discrepancy is presented and discussed in the following sections.

the basic sense of one of the three verbs) and target verb phrases (involving the basic/closely related/distantly related sense of the same verb).

At the beginning of the trial, a fixation point (+) was displayed in the center of a computer screen for 2,000 milliseconds (ms), followed by the prime stimulus. The prime stimulus remained on the screen for 3,000 ms or until the participants responded, after which a target stimulus appeared, replacing the prime stimulus. After 27 trials, the participants were allowed a brief break. A practice session of 10 trials was administered to familiarize the participants with the task. The stimulus items of the practice session used none of the words used in the official testing materials.

A post hoc questionnaire was administered after the semantic judgment task (1) to ensure that the stimuli of the experiments contained usages familiar to the participants and (2) to determine whether the degree of participant familiarity with each critical stimulus affected the response time (RT). The subjects indicated how often each critical stimulus occurs in their lives, either receptively or productively, on a 7-point Likert scale. The entire experiment for each participant was completed in approximately 30 minutes.

4. Results

Before statistical analysis, data from three participants were removed because of unexpected interference during the priming task. Data from trials in which subjects pressed the *no* button for prime stimuli or in which the experimental RTs were less than 80 ms or more than 2,500 ms were also excluded. This resulted discarding 9% of the data. In addition, we also excluded data from trials over the two phrases which resulted in a score of less than 4 on the familiarity questionnaire.[7] Of the remaining data, only positive responses (*yes*) to the target stimuli were included in the analyses.

Figure 1 and Table 5 present the mean target RTs and positive response rates for each condition.

As the target verb senses became less related to the basic sense, the mean target positive response rate declined (same senses: 99%; closely related senses: 91%; distantly related senses: 84%), and the mean target RTs increased (same senses: 704 ms; closely related senses: 865 ms; distantly related senses: 993 ms). These results clearly indicate that the less the target verb sense related to the basic sense, the lower the positive target response rate became. This also yielded a longer positive target RT.

[7] The average scores for *xǐ zuìzhàng* 'to eliminate sin' and *xǐ guójí* 'to change nationality for a higher social status' were 3.83 and 2.69, respectively. The RTs of these stimuli from all trials were subsequently removed because the verb phrases were not as familiar to the subjects as expected. The elimination did not significantly change the results of the inferential statistical analysis.

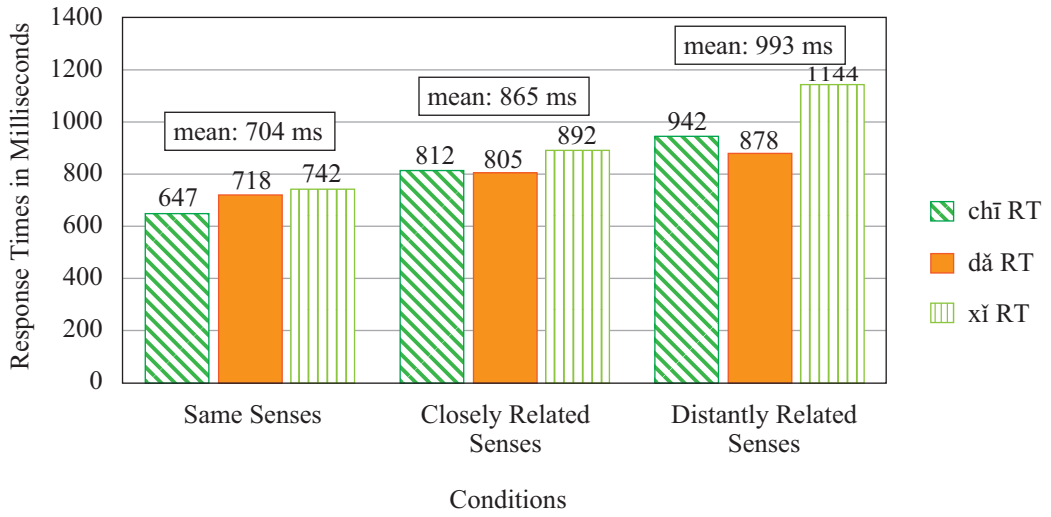

Figure 1. Mean RTs (ms) for each condition

Table 5. Mean target positive response rates

Conditions \ Verbs	*chī*	*dǎ*	*xǐ*	*Total Mean*
Same senses	100%	98%	99%	99%
Closely related senses	95%	88%	88%	91%
Distantly related senses	87%	89%	71%	84%

Xǐ 'wash' was the most sensitive to condition change, whereas *dǎ* 'hit' was the least sensitive. Moreover, *xǐ* received the longest average RT in each condition. *Dǎ* received the shortest average RT in the distantly related sense condition, even shorter than the average RTs for *xǐ* and *chī* in the closely related sense condition.

Although the average target processing time for all the verbs increased as the prime and target stimuli became more unrelated, we examined the mean target RTs for each subsense to determine whether they were processed at a similar rate in each condition. Table 6 presents the mean RTs for each extended sense.

Closer inspection of the data reveals that not all extended senses resulted in similar processing times: the closely related senses of *dǎ* 'to play (ball games)' (mean RT: 683 ms) and *xǐ* 'to develop (photos)' (mean RT: 719 ms) were processed faster, even when compared with the average RTs of their basic senses, as shown in Table 6. On the other hand, another closely related extended sense of *dǎ* 'to play percussion instruments' was processed more slowly (mean RT: 928 ms), it received a longer average RT than did two distantly related senses of the verb. Regarding the distantly related sense condition, *dǎ* 'to plan, to determine' (mean RT: 798 ms) received RTs that were shorter than the average RT of *dǎ* in the closely related sense condition.

Table 6. Mean target response times (ms) of each sense

Conditions	Extended senses	RTs
Closely related senses	*chī* 'to eat'	
	• Sense: to eat at a certain location	835
	• Sense: to eat non-typical food	788
	dǎ 'to hit'	
	• Sense: to play percussion instruments	928
	• Sense: to play (ball games)	683
	xǐ 'to wash'	
	• Extension principle: *xǐ* + non-typical noun (to wash or clean at a certain location or in a certain manner)	926
	• Sense: to develop (photos)	719
Distantly related senses	*chī* 'to eat'	
	• Sense: to suffer	955
	• Sense: to live off (somebody/ something)	916
	dǎ 'to hit'	
	• Sense: to plan, to determine	798
	• Sense: to apply	969
	• Sense: to interact with people	856
	xǐ 'to wash'	
	• Extension principle I[8]	1127
	• Extension principle II	1161

Concerning the familiarity ratings of the stimuli, the results of the post-experiment questionnaire presented in Figure 2 indicate that the participants were familiar with most of the experimental stimuli.

The *chī* phrases all received a score exceeding 6 points on the 7-point Likert scale. Except for *dǎ mùqín* 'to play the xylophone' (mean familiarity rate: 4.20), the stimuli constructed using *dǎ* also received high familiarity ratings. Two phrases involving *xǐ*, however, were not as familiar to the participants, namely *xǐ guójí* 'to change nationality for a higher social status' (mean familiarity rating: 2.69) and *xǐ zuìzhàng* 'to eliminate sin' (mean familiarity rating: 3.83). Therefore, these two stimuli were eliminated from the analysis.

The target item means were subjected to a 3 (Condition) × 3 (Verb Type) analysis of covariance in which mean familiarity was the covariate. The analysis revealed no significant interaction between Condition, Verb Type, and Familiarity, $F(8, 36) = 2.10$, $p = .06$.

[8] Please refer to footnote 3.

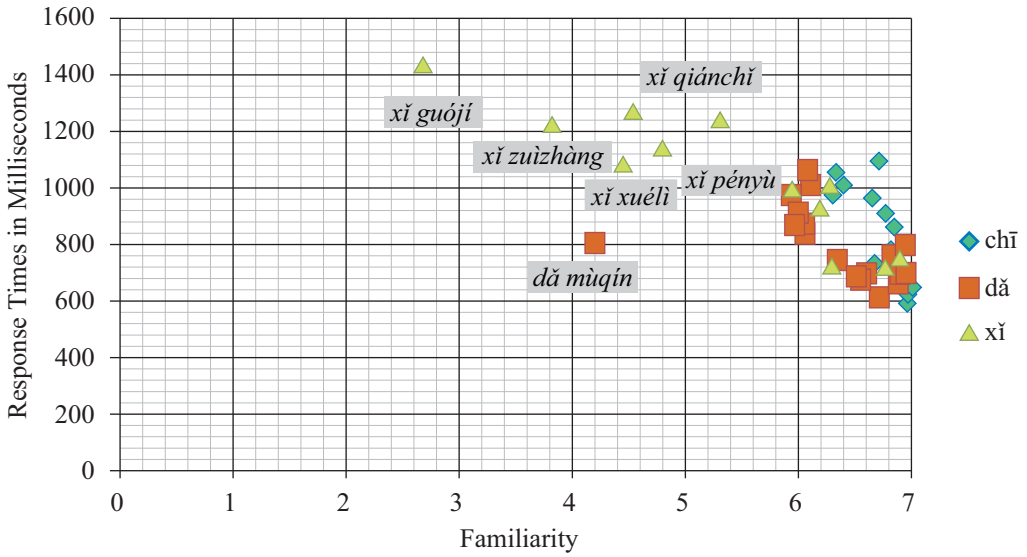

Figure 2. Mean response times (ms) and familiarity for each target stimuli

A significant linear relationship between familiarity and transformed target RTs (obtained using the Box-Cox Transformation, $\lambda = -1.25$) was perceived, as presented in Type III SS, $F(1, 44) = 20.46$, $p < .0001$, $1p^2 = 0.33$, 95% confidence interval (CI) [0.094, 0.462], indicating a shorter processing time for more familiar verb phrases. No significant effects of Verb Type were observed, $F(2, 44) = 1.59$, $p = .22$, revealing the main effects of Condition in the analysis, $F(2, 44) = 10.34$, $p = .0002$, $1p^2 = 0.33$, 95% CI [0.083, 0.458], and no interaction between Condition and Verb Type was found, $F(4, 44) = 1.50$, $p = .22$.

Post hoc comparisons using the Tukey-Kramer method ($p < .05$) revealed significant RT differences between each pair of the three conditions. First, a sense-consistency effect was observed: Participants reacted significantly faster to target items in the same senses condition than to those in the closely related sense condition ($q = \pm 2.48$, $p < .05$) and distantly related sense condition ($q = \pm 4.54$, $p < .01$). A relatedness effect was perceived: Target items in the closely related sense condition also received quicker reactions than did those in the distantly related sense condition ($q = \pm 2.73$, $p < .05$). Table 7 presents the differences between the least squares means for the effect of each pair of the three conditions.

In summary, the experimental results revealed that extended senses being further from the basic sense cause longer processing times, and most stimuli were frequently viewed and used by the subjects in daily life. Statistical analyses indicated the effects of familiarity and sense relatedness during semantic processing. The model accounted for a significant amount of the variation in the experiment, namely nearly 71% (R-Square = 0.71).

Table 7. Least squares means for effect of each pair of conditions

Verb types / Conditions	Same senses	Closely related senses	Distantly related senses
Same senses		-2.48 ($p < .05$)	-4.54 ($p < .01$)
Closely related senses	2.48 ($p < .05$)		-2.73 ($p < .05$)
Distantly related senses	4.54 ($p < .01$)	2.73 ($p < .05$)	

5. Discussion

5.1 Research question 1: Do degree of sense relatedness and degree of familiarity with a verb phrase affect semantic processing time?

In general, sense relatedness facilitated the RTs of target phrases: a higher degree of sense relatedness results in shorter processing times. Nevertheless, we observed an RT difference among the verbs. The average RT of *dǎ* in the distantly related sense condition was markedly shorter compared with that in the other two conditions, possibly because the *dǎ* stimuli in this condition were more lexicalized than those in the other conditions. For example, in *dǎ jiāodào* 'to have dealings with someone' (mean RT: 799 ms), hardly any verb other than *dǎ* can be used with *jiāodào* to express the same meaning. However, for *chī guānsī* 'to be sued' (mean RT: 1,092 ms), a similar meaning can be expressed using *āi guānsī* or *rěshàng guānsī*. Some extended senses were actually processed more quickly than the mean RTs of the verb senses that were more related to their basic senses. *Dǎ* 'to play (ball games)' and *xǐ* 'to develop (photos)' in the closely related sense condition, and *dǎ* 'to plan, to determine' in the distantly related sense condition received shorter RTs compared with other senses in the same conditions. A possible explanation for this is that the stimuli used in the trials have high recurrence and cooccurrence rates. For example, the cooccurrence of *dǎ zhǔyì* (hit, idea) 'to plan a scheme' (139 times) is higher than the cooccurrence of *dǎ bǐyù* (hit, rhetorical comparison) 'to make a rhetorical comparison' (39 times, as retrieved from Chinese Word Sketch). This illustrates how the distantly related sense may undergo abstraction caused by lexicalization and recurrence in common daily usage (e.g. *xǐ zhàopiàn* (wash, photo) 'to develop photos').

Concerning familiarity, the experimental results revealed that familiarity facilitated processing times for stimuli (Figure 2). Although familiarity plays a large role, it is worth noting that more than 88% of the target stimuli were rated as familiar; that is, they received more than 5 points on the 7-point Likert scale, and 90% of these famil-

iar targets received 6 points. The phrases that were less familiar to the participants were primarily literary expressions (e.g. *xǐ qiánchǐ* 'to expunge previous humiliation' and *xǐ zuìzhàng* 'to eliminate sin') and non-standardized popular expressions (e.g. *xǐ guójí* 'to change nationality for a higher social status' and *xǐ xuélì* 'to hide an unsatisfactory academic history by studying at a more prestigious educational institution). From above examples, it's also reasonable to conclude that the nature of both expressions itself may cause participants' unfamiliarity." For instance, *Xǐ* had a particularly long average RT in the distantly related sense condition, most likely because the stimuli were less familiar to the participants.

5.2 Research question 2: Are polysemous senses stored separately or do they share a core meaning or any general representation?

The separate-entry theory maintains that processing various ambiguous senses of a polysemous word would be the same, because these senses, despite being related, do not overlap much functionally. By contrast, the core-meaning theory proposes that there is a generative semantic representation shared by polysemous senses, which a generative semantic representation shared by polysemous senses, which may result in distinct patterns when senses with differing degrees of relatedness are processed. Overall, the current results are more consistent with the core-meaning theory. A sense–consistency effect was reflected in the RTs and was greater for distantly related senses than for closely related senses.[9] In other words, as compared with subjects required significantly more time to react to targets in the distantly related sense condition than to targets in the closely related sense condition. Moreover, relatedness clearly exerted an effect in that subjects responded to closely related senses faster than they did to distantly related senses.

The separate representation account, as supported by Klein & Murphy (2001, 2002), neither assumes a difference in the sense–consistency effect between two types of ambiguity nor predicts a semantic overlap between each pair of polysemous senses (e.g. the senses of *paper* in "wrapping *paper*" and "liberal *paper*" are independent of each other). However, in their experiments, only two distinct senses of each polysemous word were tested at a time, neglecting semantic nuances involved in polysemous words that possess more than three senses. The three polysemous verbs used in the present study are all semantically rich and complex, enabling examination of the processing patterns of each type of polysemous sense within a word. Our findings

[9] Although familiarity plays a role, more than 88% of the target stimuli were given more than 5 points out of 7, and 90% of such target stimuli were given 6 points. See Figure 2 for a more detailed distribution pattern.

conflict with the separate-entry theory, providing evidence that although facilitation for the same sense and inhibition for a different sense were apparent, the inhibition effect regarding the closely related sense condition was smaller than that for the distantly related sense condition; therefore, the sense-consistency effects differed for dissimilar types of senses. Furthermore, a significant qualitative distinction between senses with different degrees of relatedness was revealed, indicating a correlation between semantic relatedness and semantic overlap. Senses that are more related to the basic sense overlap more in their psychological representations than do senses that are less related to the basic sense. Therefore, any theory that does not include a shared representation of senses is clearly disconfirmed by our results.

Our results are more compatible with the core-representation view. Although the present findings cannot be explained using an extreme core-meaning theory that assumes similar processing patterns for each condition, they imply a shared general representation, the size of which may differ according to the degree of semantic relatedness.

This study is not the first in which the effect of relatedness was demonstrated in a lexical processing task. Both Rodd, Gaskell & Marslen-Wilson (2002) and Klepousniotou & Baum (2007) revealed a processing advantage for related senses in lexical decision tasks. In particular, Klepousniotou & Baum (2007) and Klepousniotou et al. (2012) demonstrated a qualitative difference within polysemy: Words with metonymically extended senses resulted in shorter reaction times than did words with metaphorically extended senses, indicating that polysemous words with closely related senses are recognized faster than are those with distantly related senses. The authors explained their results by adopting a model proposed by Rodd, Gaskell & Marslen-Wilson (2004), in which unrelated meanings correspond to separate semantic representations, whereas related senses could form single, larger, shallower attractor basins in the same region of the semantic space. Therefore, in contrast to metaphorical words, metonymically polysemous words have more related senses and, thus, broader attractor basins that accelerate lexical recognition. Nevertheless, the model proposed by Rodd, Gaskell & Marslen-Wilson (2004) was inapplicable to our experiment, in which only a specific sense was intended to be retrieved. According to their model, inhibitions may arise owing to competition among different related senses.

Similar results to those in the present study that could explain the grading of priming effects have been provided by Klepousniotou (2002) and Brown (2008), the experiments of whom activated only one particular sense at a time and the effect of relatedness was also perceived.

One possible explanation for the results of the present study is that closely related senses share a core meaning with the basic sense, whereas distantly related senses are

listed as separate entries in the mental lexicon. Klepousniotou (2002) discovered that although the results were inconsistently significant, metonymous words exerted a greater priming effect and were processed faster than metaphorical words. A possible reason for this is that although metonymically extended senses are generated by rules, metaphorically extended senses lie between metonymy and homonymy; thus, some senses share a general representation with the dominant sense, whereas some senses are stored as separate representations in the mental lexicon. Although Klepousniotou did not discuss the psychological representation of a polysemous word that possesses both metonymically extended senses and metaphorically extended senses, similar to our critical verbs, we can infer from this account that a core meaning or a general semantic representation may be shared by the basic senses and the closely related senses, most of which are metonymically extended. The distantly related senses used in the present experiment, by contrast, may be too far from the basic senses and are thus independent entries, requiring extra effort to retrieve. However, no homonymous meaning was applied in this study. Proving a substantial distinction between distantly related senses and homonymy may falsify the model described previously.

A second possible explanation for the present results is the concept of semantic hierarchy, a view of polysemous senses that relates to the semantic network introduced by Langacker (1988), in which a unidirectional semantic network of nodes represents polysemous senses and links depicting relationships of extensions. Several empirical results correspond to the hierarchical categorizing view. For example, Williams (1992), using a lexical decision priming task and a relatedness judgment task, suggested that central meanings are more easily accessed in unrelated contexts than noncentral meanings are, possibly because the structure of sense representations is hierarchical.

Similar to our study, Brown (2008) observed a linearly increasing progression of RTs for senses moving from the core senses through the closely related senses to the distantly related senses. Brown claimed that within a single entry there are polysemous subentries, under which lie other subentries that house less related senses.

In addition, neurophysiological evidence may also be compatible with the hierarchical view in that MEG results suggest individually listed senses with a shared abstract semantic representation (Pylkkänen, Llinás & Murphy, 2006). The present data correspond with the hierarchical view because we observed decreasing priming effects when the sense of the target verb was less related to its basic sense. According to this perspective, the basic sense could be considered to possess most of the semantic features shared by all the polysemous senses. Closely related senses, which are located lower in the semantic hierarchy because of semantic extension from the basic sense, are subentries that share less core representation, thus resulting in longer

processing times. Distantly related senses, which may be derived from either a basic sense or closely related senses, are another condition of subentries situated on a much lower level in the structure because they share least with the general representation, thereby requiring much more effort to access. In summary, contrary to the argument presented by Klein & Murphy (2001), the size of the shared core semantic features may vary for each extended sense, and this general representation is not only valid in linguistic analysis, but is crucial in online semantic processing.

6. Conclusion

The experiment presented in this paper not only examined the effects of sense relatedness and familiarity in semantic processing, but also tested contrasting theories of the nature of polysemous senses. Moreover, this study explored the discussion of sense representation by providing possible models for polysemous words which possess various sense subtypes. The results indicate that both relatedness of meaning and familiarity affect polysemy processing time, suggesting two possible models of mental representation for polysemous verbs in Mandarin. Nevertheless, some limitations of this study should be noted. First, some phrases used in the experiment were relatively new to our participants (e.g. *xǐ xuélì* 'to hide an unsatisfactory academic history by studying at a more prestigious educational institution'), resulting in unbalanced positive response rates. Second, because we applied no homonymous senses in the experiment, the question as to whether there is a qualitative difference between distantly related senses and homonymy remains unresolved. Finally, because our prime stimuli were the basic senses of three critical verbs, we do not know if the linear effect would be present in a reversed priming task, namely a sensicality priming task in which closely related senses and distantly related senses serve as prime stimuli, and basic senses serve as target stimuli. The results of a reversed priming task may be crucial for determining a more plausible model. Further studies are warranted to address these limitations.

Appendix. Materials

PRIME STIMULI	
Verb types	Stimuli
chī (to eat)	• Basic sense: to swallow food through the mouth (to eat) *chī píngguǒ* (eat, apple) (to eat apples) *chī niúpái* (eat, steak) (to eat steak) *chī yùmǐ* (eat, corn) (to eat corn) *chī niángāo* (eat, rice cake) (to eat rice cake) *chī pàomiàn* (eat, instant noodles) (to eat instant noodles) *chī qīngcài* (eat, vegetable) (to eat vegetables) *chī zhájī* (eat, fried chicken) (to eat fried chicken) *chī dàngāo* (eat, cake) (to eat cake) *chī yúchì* (eat, shark's fin) (to eat shark's fin)
dǎ (to hit)	• Basic sense: to hit a certain object with a hand or with an instrument held in the hand (to hit) *dǎ zhāngláng* (hit, cockroach) (to hit a cockroach) *dǎ guānyuán* (hit, officer) (to hit an officer) *dǎ qièzéi* (hit, burglar) (to hit a burglar) *dǎ lǎoshī* (hit, teacher) (to hit a teacher) *dǎ cáipàn* (hit, umpire) (to hit an umpire) *dǎ xuéshēng* (hit, student) (to hit a student) *dǎ huàirén* (hit, bad guy) (to hit a bad guy) *dǎ wénzi* (hit, mosquito) (to hit a mosquito) *dǎ sījī* (hit, driver) (to hit the driver)
xǐ (to wash)	• Basic sense: to clean the dirt with water or cleaner (to wash) *xǐ shēntǐ* (wash, body) (to wash one's body) *xǐ wàzi* (wash, socks) (to wash socks) *xǐ shuǐguǒ* (wash, fruit) (to wash fruit) *xǐ shuǐtǎ* (wash, water tower) (to clean a water tower) *xǐ dìtǎn* (wash, carpet) (to wash/clean one's carpet) *xǐ chuānglián* (wash, curtain) (to wash curtains) *xǐ yīfú* (wash, clothes) (to wash clothes) *xǐ chuānghù* (wash, window) (to clean windows) *xǐ nèikù* (wash, underwear) (to wash underwear)

TARGET STIMULI	
Same senses	
Verb types	Stimuli
chī (to eat)	*chī tāngyuán* (eat, rice ball) 'to eat rice balls' *chī tángguǒ* (eat, candy) 'to eat candies' *chī zòngzi* (eat, rice dumpling) 'to eat rice dumplings' *chī bǐnggān* (eat, cookie) 'to eat cookies' *chī shǔtiáo* (eat, fries) 'to eat fries' *chī yuèbǐng* (eat, mooncake) 'to eat mooncakes'
dǎ (to hit)	*dǎ xiǎohái* (hit, kid) 'to hit kids' *dǎ jǐngchá* (hit, police) 'to hit a police officer' *dǎ lǎopó* (hit, wife) 'to hit a wife' *dǎ lìwěi* (hit, legislator) 'to hit a legislator' *dǎ xiǎotōu* (hit, thief) 'to hit a thief' *dǎ nǚrén* (hit, woman) 'to hit women'
xǐ (to wash)	*xǐ chuángdān* (wash, bed sheet) 'to wash a bed sheet' *xǐ wǎnkuài* (wash, bowls and chopsticks) 'to wash bowls and chopsticks' *xǐ pánzi* (wash, dish) 'to wash dishes' *xǐ tóufǎ* (wash, hair) 'to wash one's hair' *xǐ máobǐ* (wash, writing brush) 'to wash a writing brush' *xǐ guōzi* (wash, pot) 'to wash pots'
Closely related senses	
chī (to eat)	• Sense: to eat at a certain location *chī xǐjiǔ* (eat, wedding feast) 'to attend a wedding feast' *chī mósī* (eat, Mos Burger) 'to eat at Mos Burger (a burger chain)' *chī wěiyá* (eat, year-end party) 'to attend a year-end party' • Sense: to eat atypical food[10] *chī gānzhè* (eat, sugarcane) 'to chew sugarcane' *chī nǎizuǐ* (eat, pacifier) 'to suck on a pacifier' *chī bīnláng* (eat, areca nut) 'to chew areca nut'
dǎ (to hit)	• Sense: to play percussion instruments *dǎ dàgǔ* (hit, bass drum) 'to play the bass drum' *dǎ xiǎngbǎn* (hit, castanets) 'to play the castanets'

[10] Note that for these stimuli, the action of the verbs does not conform to the basic sense of *chī* in that it does not entail any swallowing process. The objects following the verbs are atypical food in that people suck and chew them but do not swallow them. Therefore, these constructions were sorted in the closely related senses.

	dǎ mùqín (hit, xylophone) ‘to play the xylophone’ • Sense: to play (ball games) *dǎ páiqiú* (hit, volleyball) ‘to play volleyball’ *dǎ yǔqiú* (hit, badminton) ‘to play badminton’ *dǎ lánqiú* (hit, basketball) ‘to play basketball’
xǐ (to wash)	• Extension principle: *xǐ* + atypical noun (to wash or clean at a certain location or in a certain manner) *xǐ rèshuǐ* (wash, hot water) ‘to take a hot shower’ *xǐ lěngquán* (wash, cold spring) ‘to bathe in a cold spring’ *xǐ wēnquán* (wash, hot spring) ‘to bathe in a hot spring’ *xǐ pényù* (wash, tub) ‘to bathe in a tub’ *xǐ lěngshuǐ* (wash, cold water) ‘to take a cold shower’ • Sense: to develop (photos) *xǐ zhàopiàn* (wash, photo) ‘to develop photos’
Distantly related senses	
chī (to eat)	• Sense: to suffer *chī guānsī* (eat, lawsuit) ‘to be sued’ *chī kǔtou* (eat, hardship) ‘to suffer from hardship’ *chī bàizhàng* (eat, lost battle) ‘to lose a battle’ *chī mènkuī* (eat, silent, lost) ‘to be compelled to suffer in silence’ • Sense: to live off (somebody/ something) *chī lǎoběn* (eat, original capital) ‘to rest on one’s laurels’ *chī zìjǐ* (eat, oneself) ‘to depend on oneself’
dǎ (to hit)	• Sense: to plan, to determine *dǎ zhǔyì* (hit, idea) ‘to plan a scheme’ *dǎ cǎogǎo* (hit, draft) ‘to prepare a draft’ • Sense: to apply *dǎ bǐyù* (hit, rhetorical comparison) ‘to make a rhetorical comparison’ *dǎ guānqiāng* (hit, bureaucratic tone) ‘to speak in a bureaucratic tone’ • Sense: to interact with people *dǎ jiāodào* (hit, principles of communication) ‘to have dealings with someone’ *dǎ zhàomiàn* (hit, encounter) ‘to come face to face with someone’
xǐ (to wash)	• Extension principle: TO WASH IS TO CHANGE FROM THE STATE OF HAVING SOMETHING TO THE STATE OF BEING ALMOST EMPTY *xǐ yuānqū* (wash, injustice) ‘to right a wrong’

	xǐ qiánchǐ (wash, previous humiliation) 'to expunge previous humiliation' *xǐ zuìzhàng* (wash, sin) 'to eliminate sin' • Extension principle: TO WASH IS TO CHANGE FROM THE STATE OF BEING ILLEGAL (BAD) TO THE STATE OF BEING LEGAL (GOOD) *xǐ hēiqián* (wash, corrupt money) 'to launder money' *xǐ guójí* (wash, nationality) 'to change nationality for a higher social status' *xǐ xuélì* (wash, academic history) 'to hide an unsatisfactory academic history by studying at a more prestigious educational institution'

FOILS		
Verb types	Stimuli	
	Primes	Targets
chī (to eat)	**chī diànnǎo* (eat, computer) **chī línggōng* (eat, odd job) **chī hàn* (eat, sweat) *chī jī pái* (eat, chicken cutlets) 'to eat chicken cutlets' *chī zǎofàn* (eat, breakfast) 'to eat breakfast' *chī wǔfàn* (eat, lunch) 'to eat lunch' **chī fēngshuǐ* (eat, feng shui) **chī lěngshuǐzǎo* (eat, cold water shower) **chī nèihán* (eat, thoughtfulness)	**chī xīnqíng* (eat, mood) **chī jǐng* (eat, water well) **chī gǔpiào* (eat, stock) **chī zhàndòuzǎo* (eat, quick shower) **chī yùnqì* (eat, luck) **chī zhōng* (eat, clock) *chī wǎncān* (eat, dinner) 'to eat dinner' *chī niányèfàn* (eat, New Year's Eve dinner) 'to have New Year's Eve dinner' *chī biàndāng* (eat, boxed meal) 'to eat a boxed meal'
dǎ (to hit)	**dǎ biàntiáo* (hit, notepaper) **dǎ hǎixiān* (hit, seafood) **dǎ tāngyuán* (hit, riceball) *dǎ diànhuà* (hit, phone) 'to make a phone call' *dǎ zhāohū* (hit, greeting) 'to greet' *dǎ duōsuō* (hit, tremble) 'to tremble' **dǎ tǐlì* (hit, energy) **dǎ cāntīng* (hit, restaurant)	**dǎ bànzhuō* (hit, roadside banquet) **dǎ dàfàndiàn* (hit, grand hotel) **dǎ tǐlì* (hit, energy) **dǎ xīnqíng* (hit, mood) **dǎ zhòngxián* (hit, salty food) **dǎ yùnqì* (hit, luck) *dǎgé* 'to burp' *dǎ gāoěrfū* (hit, golf) 'to play golf'

	**dǎ kěndéjī* (hit, Kentucky Fried Chicken)	*dǎ línggōng* 'to do odd jobs'
xǐ (to wash)	**xǐ gǔ* (wash, drum) **xǐ hēqiàn* (wash, yawn) **xǐ chēzhàn* (wash, station) *xǐ jiǎo* (wash, feet) 'to wash feet' *xǐ liǎn* (wash, face) 'to wash one's face' *xǐ yá* (wash, teeth) 'to have dental scaling' **xǐ dàjú* (wash, whole situation) **xǐ xiǎoshuō* (wash, fiction) **xǐ shūběn* (wash, book)	**xǐ rènào* (wash, bustle) **xǐ lì* (wash, strength) **xǐ kuī* (wash, loss) **xǐ guójìsài* (wash, international competition) **xǐ miànxiàng* (wash, face) **xǐ chuāncài* (wash, Sichuan cuisine) *xǐ shǒu* (wash, hand) 'to wash one's hands' *xǐ mǐ* (wash, rice) 'to wash rice' *xǐ cài* (wash, vegetable) 'to wash vegetables'

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Department of Chinese as a Second Language
National Taiwan Normal University
Taipei, TAIWAN
Huichen S. Hsiao: huichen.hsiao@ntnu.edu.tw
Yi-Chun Chen: phoebe7979@gmail.com
Ying-Chen Wu: yingchen.wu31@gmail.com

華語多義詞詞義表徵—
以「吃」、「打」、「洗」為例

蕭惠貞　　陳意鈞　　吳盈臻
國立臺灣師範大學

本研究藉由語義判斷促發任務，探究現代漢語中含有豐富延伸義的三個多義詞「吃」、「打」、「洗」之不同義項在心理詞彙中的表徵。在促發任務實驗中，所有促發材料為以三個動詞基本義所構成之詞組，並控制探測材料與促發材料之詞義相關性，共分為「相同義項（如：吃牛排）」、「高度相關義項（如：吃尾牙）」、「低度相關義項（如：吃老本）」三組，以了解多義詞內不同延伸詞義的類型是否會出現不同的處理模式。研究結果顯示促發效應隨著詞義相關性越低而遞減。此結果不符合多重詞條假說，能夠作為多義詞各義項間存在核心表徵的支持。

關鍵詞：詞彙歧義、多義詞、語義促發、詞義相關性