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Harris, Sandra, "Questions as a Mode of Control in Magistrates' Courts", *International Journal of the Sociology of Language* 49, 1984, 5–27.

Levi, Judith N., *Language in the Judicial Process*, New York: Plenum Press, 1990.

Loftus, Elizabeth, "Leading Questions and Eyewitness Report", *Cognitive Psychology* 7, 1975, 560–572.

Liao, Meizhen [Liào Měizhēn 廖美珍], *Zhōngguó fǎtíng wèn-dá jīqì hùdòng yánjiū* 中国法庭问答机器互动研究 [A study of courtroom questions, responses and their interaction in Chinese courtoom discourse], Běijīng 北京: Fǎlǜ 法律出版社, 2003.

Liao, Meizhen [Liào Měizhēn 廖美珍], *Fǎtíng yǔyán jìqiǎo* 法庭语言技巧 [Trial communication strategies], Běijīng 北京: Fǎlǜ 法律出版社, 2009a.

Liao, Meizhen, "A Study of Interruption in Chinese Criminal Courtroom Discourse", *Text and Talk* 29/2, 2009b, 175–199.

Liao, Meizhen, "Power in Interruption in Chinese Criminal Courtroom Discourse", in: Christopher Williams and Girolamo Tessuto, eds., *Language in the Negotiation of Justice*, England: ASHGATE, 2013, 33–48.

Liào Měizhēn 廖美珍 and Sū Jīnzhì 苏金智, *Fǎtíng yǔyánxué yìcóng* 法律语言学译丛" [A translation series in forensic linguistics], Běijīng 北京: Fǎlǜ 法律出版社, 2007.

Merritt, Marilyn, "On Question Following Question in Service Encounters", *Language in Society* 5, 1976, 315–357.

O'Barr, Wiliam, *Linguistic Evidence: Language, Power and Strategy in the Courtroom*, New York: Academic Press, 1982.

Meihzen Liao

Lexical and Sublexical Access

A central question in psycholinguistic research concerns the type of information stored and the way in which information is represented in the mental lexicon. Researchers are concerned with (1) whether Chinese characters have representations at a lexical level and how they are represented (Perfetti *et al.* 2005, Taft 2006, Tsang and H.-C. Chen 2009); (2) whether sub-character information (radicals or strokes) is represented in the mental lexicon and how it is represented (e.g., Ding *et al.* 2004, Luo *et al.* 2014, in press, L. Zhou *et al.* 2013); (3) to what extent phonological mediation plays a role in constraining semantic activation in reading Chinese and how processing of radicals embedded in Chinese complex characters contributes to phonological activation of whole characters (X. Zhou *et al.* 1999, X. Zhou and Marslen-Wilson 1999a, 1999b, 2000); and, finally, (4) how words are segmented when reading, given that there are no spaces between words in Chinese (e.g., X. Li *et al.* 2009). In the following sections, we review recent studies that address these topics.

1. Orthography of Chinese Characters

The Chinese script is a logographic script. Chinese characters are primarily divided into two categories: simple and complex characters. Simple characters make up about 5% of the total characters in use today and are visual patterns that cannot be divided meaningfully into sub-lexical units, such as 犬 *quǎn* 'dog' and 青 *qīng* 'blue'. Complex characters constitute about 95% of all characters and have two or more functional components, or radicals (X. Zhou and Marslen-Wilson 1999c). About 80% of complex characters are phonetic compounds that consist of two functional components. A phonetic radical provides cues to the pronunciation of its host character, and a semantic radical usually provides cues to the meaning of its host character. For example, 媽 *mā* 'mother' is constructed with phonetic radical 馬 *mǎ* 'horse' and semantic radical 女 *nǚ* 'female'. About 13% of complex characters are ideogrammic compounds, which symbolically combine two or more radicals to create a third character, and these radicals are not related to the host character in pronunciation (D. Li 1993). For instance, combining 日 *rì* 'sun' and 月 *yuè* 'moon', the two natural sources of light, makes 明 *míng* 'bright'.

2. Models of Chinese Word Reading

Three models have been proposed to explain the sub-lexical processing in reading complex characters. Derived from a connectionist structure of lexical representation (e.g., Plaut *et al.* 1996, Seidenberg *et al.* 1989), the generic model proposed by X. Zhou and his colleagues (X. Zhou *et al.* 1999) emphasizes the predominant role of orthography in initial lexical access. They assumed that all orthographic elements associated with Chinese morphemes are represented at the same level in the mental lexicon, regardless of whether these elements are characters, phonetic radicals, or semantic radicals (X. Zhou *et al.* 1999, X. Zhou and Marslen-Wilson 1999c). These orthographic representations have direct links with representations in phonological and semantic systems. When reading compound characters, the visual input is automatically decomposed into different orthographic units that map in parallel to orthographic representations in the mental lexicon (X. Zhou *et al.* 1999a, X. Zhou and Marslen-Wilson 1999d).

The lexical constituency model (Perfetti *et al.* 2005) stresses the role of phonology. It assumes that a written word representation includes three interlocking constituents: orthography, phonology, and semantics, and that word recognition entails the retrieval of all three constituents (Tan and Perfetti 1998). In the orthographic system in Chinese, radicals, which themselves can be free-standing characters, are represented at both radical and lexical levels (Perfetti *et al.* 2005). However, this model does not specify how the representations of radicals connect to their corresponding phonology and semantics.

Taft and his colleagues proposed a further detailed hierarchical model that adopts the interactive activation framework and assumes the same three subsystems (orthography, phonology, and semantics) (Taft 2006), but makes the following additional claims (for justification see Ding *et al.* 2004, Taft and Zhu 1997): (a) simple characters and complex characters have their own lexical representations at different levels, the latter on a higher level than the former; (b) radicals that are constituents of characters are represented at the sub-lexical level; (c) there are different representations for radicals when they appear in different positions; (d) radicals that can be free-standing simple characters are represented at both the lexical and radical level.

3. Processing of Radicals

In the study of Chinese character recognition, there is accumulating evidence suggesting that the processing of radicals is involved in reading complex Chinese characters. One line of research has examined the role of statistical characteristics of phonetic and semantic radicals in character processing (M.-J. Chen and Weekes 2004, Feldman and Siok 1999, Hsiao *et al.* 2007, Lee *et al.* 2005, Q.-L. Li *et al.* 2011). For example, Lee *et al.* (2005) found effects of character frequency (how often a character is encountered), consistency (whether the sound of a character is identical with that of its phonetic radical, ignoring tonal difference), and regularity (whether the sound of a character is identical with that of its phonetic radical, ignoring tonal difference) in Chinese character naming, suggesting that the phonological information of phonetic radicals influences the naming process of Chinese characters. Similarly, regarding semantic radicals, M.-J. Chen and Weekes (2004) found that transparency (whether the meaning of a character shares the same or similar meaning as its semantic radical), combinability (the total number of character tokens that share the same semantic radical) and consistency (the ratio of the number of semantically transparent characters relative to the combinability of their semantic radicals) affected character recognition, suggesting that semantic radicals are also processed during the course of character recognition.

A second line of research is focused primarily on whether or not semantic and phonological information of the radicals are processed when reading complex Chinese characters. Some studies suggest that phonological information is activated during character recognition. For example, in a naming task, primes of low-frequency irregular complex characters facilitated naming of targets which were homophonic with the phonetic radicals embedded in the primes, while high-frequency irregular compound primes did not cause this facilitation (X. Zhou and Marslen-Wilson 1999a). These results again suggest that the phonological information of phonetic radicals affects the naming process of Chinese characters. Other studies have suggested that the meanings of radicals are activated when reading phonetic compounds (e.g., Feldman and Siok 1999, X. Zhou and Marslen-Wilson 1999c, L. Zhou *et al.* 2013) and ideogrammic compounds (Luo *et al.* 2014). For example, using a primed lexical-decision task, Feldman and Siok (1999) found that target identification is facilitated when a prime character and a target character share a semantic radical related to the prime character's meaning, yet target identification is delayed when their shared semantic radical is unrelated to the prime character's meaning. Similar priming results were obtained by L. Zhou *et al.* (2013). X. Zhou and Marslen-Wilson (1999c) observed facilitatory priming effects for targets (e.g., 紫 *zǐ* 'purple') that were semantically related to the phonetic radicals (e.g., 青 *qīng* 'blue') embedded in complex characters (e.g., 猜 *cāi* 'guess') but not to the complex characters themselves. These results implied that reading complex characters involves decomposing phonetic radicals and mapping them onto their own semantic representations, thus speeding up the responses to targets. X. Zhou and Marslen-Wilson also found an inhibitory priming effect when the semantic primes (e.g., 紫 *zǐ*) were related to the phonetic radicals (e.g., 青 *qīng*) embedded in the complex character targets (e.g., 猜 *cāi*), but not to the targets themselves, implying that pre-activation of phonetic radicals by the primes strengthens the decomposition process and semantic access of radicals, slowing down the responses to targets.

A third line of research is focused on a purely structural approach to radical processing. The primary concern of this structural approach is not so much with the functional roles of the radicals, but with the structural roles of radicals in processing characters (e.g., Yeh and J.-L. Li 2002, 2004, Taft and Zhu 1997, Tsang and H.-C. Chen 2009). For example, Yeh and J.-L. Li (2002) found that subjective judgments of the visual similarity among complex characters were based both on the characters' overall configurations (e.g., left-right or up-down structures) and on the existence of common radicals between them, yet judgments were based more on the former (configuration similarity).

4. The Role of Phonology in Character Reading

The starting point of written word recognition research was to test the dual-route model of reading (Coltheart 1978): to what extent does phonological mediation play a role in constraining semantic activation in reading Chinese and how does sub-lexical processing of radicals in Chinese characters contribute to phonological activation of whole characters? The widely accepted, intuitive thinking up until the 1980s was that Chinese characters are recognized predominantly through mapping directly between orthographic information and lexical semantic representation (for a review see X. Zhou *et al.* 2009). Perfetti and colleagues instead argued that phonology plays a 'universal role' in reading (Perfetti and Zhang 1995). They suggested that phonological information in reading Chinese, as with alphabetic scripts, is activated earlier than semantic information and access to lexical semantics depends almost exclusively on phonological activation (Perfetti and Zhang 1995; Perfetti and Tan 1998; Tan *et al.* 1996). These arguments, however, hinged upon data that were mostly not replicable (e.g., H.-C. Chen and Shu 2001; X. Zhou and Marslen-Wilson 2000). More recent evidence suggests that access to semantics in the skilled reading of Chinese is constrained by the interaction between phonology and orthography and, in addition, that phonology has no inherently privileged role over orthography in driving semantic activation (X. Zhou and Marslen-Wilson 1999a, 2000, 2009).

It should be noted that characters are not recognized in isolation during natural Chinese reading; they are usually part of a word. Hence, phonology information may be processed differently when a character is a word part. Zhan *et al.* (2013) recently used fMRI (functional magnetic resonance imaging) to investigate how phonological information is processed in the context of a compound word. They asked participants to perform a lexical decision with pseudohomophones, which were constructed by replacing one or both characters of two-character compound words with orthographically dissimilar homophonic characters. Mixed pseudohomophones that shared the first character with the base words were more difficult to reject than non-pseudohomophone non-words. This effect was accompanied by the increased activation of bilateral inferior frontal gyrus (IFG), left inferior parietal lobule (IPL), and left angular gyrus. The pure pseudohomophones, without common characters with the base words, were rejected as quickly as non-word controls and did not elicit any significant neural activation. Based on these findings, they concluded that phonological activation alone was not sufficient to drive access to lexical representations of compound words. Instead, the interaction between phonological and orthographic information plays a gating role in the recognition of Chinese compound words.

5. Word Segmentation

Unlike English, there are no spaces between words in Chinese text. However, Chinese readers have no difficulty understanding Chinese text, suggesting that they use a strategy to segment words while reading. Studies in which spaces were added between Chinese words have generally found no benefit for Chinese reading (Hsu and Huang 2000a, 2000b). However, this does not mean that words (relative to characters or morphemes) are not important in Chinese reading. Instead, many studies have showed that Chinese words have psychological reality. First, Bai *et al.* (2008) demonstrated that adding spaces between characters within words interfered with reading, while adding spaces between words did not interfere or facilitated Chinese reading. These result suggested that hindering Chinese readers from processing words as units interferes with reading. Second, J.-Y. Chen (1999) found that characters were processed more accurately when embedded in a word than a nonword string. He asked subjects to search for a Chinese character among distractors, and found that the search was faster when the character was embedded in a string of asterisks or a two-character word than in a two-character nonword or a string of scrambled characters. Third, in a study reported by X. Li *et al.* (2009), four Chinese characters, which either constituted one four-character word or two two-character words, were presented briefly to subjects. Subjects were very accurate in reporting the four-character word, yet were only able to report the first two-character word, demonstrating that word segmentation influences character recognition. The results suggest that even with these simple four-character strings, there is an element of seriality in reading Chinese words: processing is initially focused at least to some extent on the first word. In another study, X. Li *et al.* (2013) found that reading was slowed down when Chinese readers could not simultaneously see characters belonging to the same word, compared to when they could. Moreover, when Chinese readers were able to choose between viewing two characters constituting a word or two characters that did not, they evidenced a clear tendency towards looking at the two characters constituting a word. These results provide strong evidence that character processing is affected by word knowledge and by the processing of other characters belonging to the same word, and add to a growing body of evidence demonstrating that words have psychological reality for Chinese readers. Hence, Chinese readers do, in fact, need a word segmentation process during reading.

To explore the mechanism of word segmentation in Chinese reading, Inhoff and Wu (2005) embedded four characters constituting two two-character words in sentences. In the ambiguous condition, the central two characters also constituted a two-character word, while in the control condition the central two characters did not constitute a word. Using eye-tracking techniques, they found that gaze duration (the sum of all eye fixations on a word prior to moving to another word) and total viewing time (the sum of all fixations on a word, including regressions of the eyes back to the word after fixating on it earlier) were longer in the ambiguous condition than in the control condition. They argued that this result was inconsistent with what they called the unidirectional parsing hypothesis, which assumes that characters are assigned to words in a strictly serial left-to-right process. Rather, they argued that their results were consistent with what they called the multiple activation hypotheses, which assumes the activation of all of the possible words that can be combined by the characters falling into the perceptual span.

How are words segmented in Chinese reading? A model proposed by X. Li *et al.* (2009) suggested a possible way to deal with this difficult question. According to their model, there are multiple levels of processing when recognizing a Chinese word. The first level is a visual perception module that abstracts visual features from the stimulus. The second level is a character recognition module, which recognizes characters using perceptual information from the first level and feedback information from the word recognition level. On this level, there are multiple character recognizers which work in parallel. The third level is the word segmentation and recognition level. This level receives information from both the character recognizers and the lexicon. Word recognition is implemented as a process of evidence accumulation. Each character provides evidence for word recognition. If two characters provide consistent evidence for the same word, the activation of the corresponding word is higher. On the other hand, if two characters do not provide consistent evidence for the same word, the activation of the corresponding words is smaller. The word recognition level provides feedback information to the character recognition level. If a character is a part of a word with high activation, it will receive more spreading activation from the word recognition level. Hence it should be recognized faster. If a character recognizer does not receive any feedback information from the word recognition level, it can still recognize the character based on bottom-up information, but the recognition of that character will be slower. The character recognition level provides information to the word recognition level, and the word recognition level provides feedback information to the character recognition level. Thus, the model is a dynamic interactive system. At the word processing level, activated words compete for a single winner. When a word wins the competition, the word is segmented from the text and is recognized. Hence, this model suggests that word segmentation and word recognition is a unified procedure.

6. Conclusion

The Chinese script has properties that are distinct from the orthographic systems used for many Indo-European languages. Given these unique properties, research on the processing of the Chinese reading contributes to our knowledge of language-specific cognitive processes and sheds light on the universality of psycholinguistic models developed on the basis of European languages. Clearly, the present article is incomplete, both in terms of the topics covered and in terms of the publications cited. We have restricted ourselves to sublexical and lexical processing given that they are the driving force behind the neurocognitive study of the Chinese writing system. The present article is also heavily biased because the majority of studies cited are behavioral and are related to the lexical processing of written Chinese. There is an abundance of innovative studies using a variety of research techniques to investigate the the sub-lexical processing of the Chinese language (e.g., Cheung *et al.* 2004; Siok *et al.* 2004; Tan *et al.* 2013; Ye and X. Zhou 2009a, 2009b; Zhan *et al.* 2013).

Bibliography

Bai, Xuejun, Guoli Yan, Chuanli Zang, Simon P. Liversedge and Keith Rayner, “Reading Spaced and Unspaced Chinese Text: Evidence from Eye Movements”, *Journal of Experimental Psychology: Human Perception and Performance* 34, 2008, 1277–1288.

Chen, Hsuan-Chih and Hua Shu, “Lexical Activation during the Recognition of Chinese Characters: Evidence Against Early Phonological Activation”, *Psychonomic Bulletin and Review* 8, 2001, 511–518.

Chen, Jenn-Yeu, “Word Recognition during the Reading of Chinese Sentences: Evidence from Studying the Word Superiority Effect”, in: Jian Wang, Albrecht Inhoff and Hsuan-Chih Chen, eds., *Reading Chinese Script: A Cognitive Analysis*, Mahwah: Lawrence Erlbaum Associates, 1999, 239–256.

Chen, May-Jane and Brendan S. Weekes, “Effects of Semantic Radicals on Chinese Character Categorization and Character Decision”, *Chinese Journal of Psychology* 46, 2004, 181–196.

Cheung, Him, Hsuan-Chih Chen, Nikki Creed, Lisa Ng, Sui Ping Wang and Lei Mo, “Relative Roles of General and Complementation Language in Theory-of-Mind Development: Evidence from Cantonese and English”, *Child Development* 75, 2004, 1155–1170.

Coltheart, Max, “Lexical Access in Simple Reading Tasks”, in: Geoffrey Underwood, ed., *Strategies of Information Processing*, London: Academic Press, 1978, 151–216.

Ding, Guosheng, Dan-ling Peng and Marcus Taft, “The Nature of the Mental Representation of Radicals in Chinese: A Priming Study”, *Journal of Experimental Psychology: Learning, Memory, and Cognition* 30, 2004, 530–539.

Feldman, Laurie Beth and Witina W.T. Siok, “Semantic Radicals Contribute to the Visual Identification of Chinese Characters”, *Journal of Memory and Language* 40, 1999, 559–576.

Hsiao, Janet Hui-Wen, Richard Shillcock and Michal Lavidor, "An Examination of Semantic Radical Combinability Effects with Lateralized Cues in Chinese Character Recognition", *Attention, Perception and Psychophysics* 69/3, 2007, 338–344.
Hsu, Sheng-Hsiung and Kuo-Chen Huang, "Effects of Word Spacing on Reading Chinese Text from a Video Display Terminal", *Perceptual and Motor Skills* 90, 2000a, 81–92.
Hsu, Sheng-Hsiung and Kuo-Chen Huang, "Interword Spacing in Chinese Text Layout", *Perceptual and Motor Skills* 91, 2000b, 355–365.
Inhoff, Albrecht W. and Cai-Li Wu, "Eye Movements and the Identification of Spatially Ambiguous Words during Chinese Sentence Reading", *Memory & Cognition* 33, 2005, 1345–1356.
Lee, Chia-Ying, Jie-Li Tsai, Erica Chung-I Su, Ovid J.L. Tzeng and Daisy L. Hung, "Consistency, Regularity, and Frequency Effects in Naming Chinese Characters", *Language and Linguistics* 6/1, 2005, 75–107.
Li, Dan, *A Study of Chinese Characters*, Beijing: Peking University Press, 1993.
Li, Qing-Li, Hong-Yan Bi, Tong-Qi Wei and Bao-Guo Chen, "Orthographic Neighborhood Size Effect in Chinese Character Naming: Orthographic and Phonological Activations", *Acta Psychologica* 136, 2011, 35–41.
Li, Xinshan, Junjuan Gu, Pingping Liu and Keith Rayner, "The Advantage of Word-Based Processing in Chinese Reading: Evidence from Eye Movements", *Journal of Experimental Psychology: Learning, Memory, and Cognition* 39/3, 2013, 879–889.
Li, Xinshan, Keith Rayner and Kyle R. Cave, "On the Segmentation of Chinese Words during Reading", *Cognitive Psychology* 58, 2009, 525–552.
Luo, Chunming, Robert W. Proctor, Xuchu Weng and Xingshan Li, "Spatial Stroop Interference Occurs in the Processing of Radicals of Ideogrammic Compounds", *Psychonomic Bulletin and Review* 21, 2014, 715–720.
Luo, Chunming, Robert W. Proctor and Xuchu Weng, "A Stroop Effect Emerges in the Processing of Complex Chinese Characters that Contain a Color-Related Radical", *Psychological Research*, forthcoming.
Perfetti, Charles A., Ying Liu and Li-Hai Tan, "The Lexical Constituency Model: Some Implications of Research on Chinese for General Theories of Reading", *Psychological Review* 112/1, 2005, 43–59.
Perfetti, Charles A. and Li-Hai Tan, "The Time Course of Graphic, Phonological, and Semantic Activation in Chinese Character Identification", *Journal of Experimental Psychology: Learning, Memory, and Cognition* 24, 1998, 101–118.
Perfetti, Charles A. and Sulan Zhang, "Very early Phonological Activation in Chinese Reading", *Journal of Experimental Psychology: Learning, Memory, and Cognition* 21, 1995, 24–33.
Plaut, David C., James L. McClelland, Mark S. Seidenberg and Karalyn Patterson, "Understanding Normal and Impaired Word Reading: Computational Principles in Quasi-regular Domains", *Psychological Review* 103/1, 1996, 56–115.
Seidenberg, Mark S. and James L. McClelland, "A Distributed, Developmental Model of Word Recognition and Naming", *Psychological Review* 96/4, 1989, 523–568.
Siok, Witina W.T., Charles A. Perfetti, Zhen Jin and Li-Hai Tan, "Biological Abnormality of Impaired Reading is Constrained by Culture", *Nature* 431, 2004, 71–76.
Tan, Li-Hai and Charles A. Perfetti, "Phonological Codes as early Sources of Constraint in Chinese Word Identification: A Review of Current Discoveries and Theoretical Accounts", *Reading and Writing: An Interdisciplinary Journal* 10, 1998, 165–200.
Tan, Li-Hai, Min Xu, Chun Qi Chang and Wai Ting Siok, "China's Language Input System in the Digital Age Affects Children's Reading Development", *Proceedings of the National Academy of Sciences of USA* 110, 2013, 1119–1123.
Tan, Li-Hai, Rumjahn Hoosain and Witina W.T. Siok, "Activation of Phonological Codes before Access to Character Meaning in Written Chinese", *Journal of Experimental Psychology: Learning, Memory, and Cognition* 22, 1996, 865–882.
Taft, Marcus and Xiaoping Zhu, "Submorphemic Processing in Reading Chinese", *Journal of Experimental Psychology: Learning, Memory, and Cognition* 23, 1997, 761–775.
Taft, Marcus, "Processing of Characters by Native Chinese Readers", in: Ping Li, Li-Hai Tan, Elizabeth Bates and Ovid J.L. Tzeng, eds., *Handbook of East Asian Psycholinguistics: Chinese*, Cambridge: Cambridge University Press, 2006, 237–249.
Tsang, Yiu-Kei and Hsuan-Chih Chen, "Do Position-general Radicals Have a Role To Play in Processing Chinese Characters?", *Language and Cognitive Processes* 24, 2009, 947–966.
Ye, Zheng and Xiaolin Zhou, "Conflict Control during Sentence Comprehension: fMRI Evidence", *Neuro Image* 48, 2009a, 280–290.
Ye, Zheng and Xiaolin Zhou, "Executive Control in Language Processing", *Neuroscience and Biobehavioral Reviews* 33, 2009b, 1168–1177.
Yeh, Su-Ling and Jing-Ling Li, "Role of Structure and Component in Judgments of Visual Similarity of Chinese Characters", *Journal of Experimental Psychology: Human Perception and Performance* 28, 2002, 933–947.
Yeh, Su-Ling and Jing-Ling Li, "Sublexical Processing in Visual Recognition of Chinese Characters: Evidence from Repetition Blindness for Sub-Character Components", *Brain and Language* 88, 2004, 47–53.
Zhan, Jiayu, Hongbo Yu and Xiaolin Zhou, "fMRI Evidence for the Interaction between Orthography and Phonology in Reading Chinese Compound Words", *Frontiers in Human Neuroscience* 7/753, 2013, doi: 10.3389/fnhum.2013.00753.

Zhou, Lin, Gang Peng, Hong-Ying Zheng, I-Fan Su and William S.-Y. Wang, "Sub-Lexical Phonological and Semantic Processing of Semantic Radicals: A Primed Naming Study", *Reading and Writing* 26, 2013, 967–989.
Zhou, Xiaolin and William D. Marslen-Wilson, "Phonology, Orthography, and Semantic Activation in Reading Chinese", *Journal of Memory and Language* 41, 1999a, 579–606.
Zhou, Xiaolin and William D. Marslen-Wilson, "Sublexical Processing in Reading Chinese", in: Jian Wang, Albrecht Inhoff and Hsuan-Chih Chen, eds., *Reading Chinese Script: A Cognitive Analysis*, Mahwah: Lawrence Erlbaum Associates, 1999b, 37–64.
Zhou, Xiaolin and William D. Marslen-Wilson, "The Nature of Sublexical Processing in Reading Chinese Characters", *Journal of Experimental Psychology: Learning, Memory, and Cognition* 25, 1999c, 819–837.
Zhou, Xiaolin and William D. Marslen-Wilson, "The Relative Time Course of Semantic and Phonological Activation in Reading Chinese", *Journal of Experimental Psychology: Learning, Memory, and Cognition* 26, 2000, 1245–1265.
Zhou, Xiaolin and William D. Marslen-Wilson, "Pseudohomophone Effects in Processing Chinese Compound Words", *Language and Cognitive Processes* 24, 2009, 1009–1038.
Zhou, Xiaolin, Hua Shu, Yanchao Bi and Dongfang Shi, "Is There Phonologically Mediated Access to Lexical Semantics in Reading Chinese", in: Jian Wang, Albrecht Inhoff and Hsuan-Chih Chen, eds., *Reading Chinese Script: A Cognitive Analysis*, Mahwah: Lawrence Erlbaum Associates, 1999, 135–171.
Zhou, Xiaolin, Zheng Ye, Him Cheung and Hsuan-Chih Chen, "Processing the Chinese Language: An Introduction", *Language and Cognitive Processes* 24, 2009, 929–946.

Chunming Luo, Xiaolin Zhou & Xingshan Li

Lexical Diffusion

1. Lexical Diffusion

Lexical Diffusion is a theory of sound change proposed by William S.-Y. Wang. The term first appeared in Wang's article "Competing Change as a Cause of Residue" in 1969. The theory of lexical diffusion challenges the traditional view of sound change as understood by a group of historical linguists of the 19th century called Neogrammarians. Sound change is not merely a change of sound as an abstract phonological entity. It is actually a change in the pronunciation of the *words* which contain the sound in question. According to the Neogrammarian hypothesis of the regularity of sound change, a diachronic sound change affects simultaneously and without exception all words meeting the same phonological condition(s). In other words, the Neogrammarian hypothesis predicts that sounds change without reference to lexicon.

Wang first encountered difficulty with such a conception of sound change when he was trying to understand a peculiar development in Cháozhōu 潮州 Chinese, where the short high tone became the short low tone during the same period that the short low tone became the short high tone. For such a tonal "flip-flop" (Wang 1967), the logical difficulty is that if X is gradually shifting toward Y during the same period of time that Y is gradually shifting toward X, then surely X and Y will merge phonetically. "Such alternations pose a striking problem for our understanding of phonological change" (Wang 1967:102). In addition, he held, because the Neogrammarian doctrine cannot provide convincing explanations for the existence of exceptions and the lexical irregularity of sound changes, the idea that sound change is lexically exceptionless and is the only mechanism of sound change must be considered false.

In Wang's 1969 article he laid out the four logical possibilities of sound change in the phonological and lexical dimensions:

1. Phonetically abrupt and lexically abrupt;
2. Phonetically abrupt and lexically gradual;
3. Phonetically gradual and lexically abrupt; and
4. Phonetically gradual and lexically gradual.

The first possibility must be ruled out because a sound cannot change from a starting state to an ending state instantaneously in all words of the lexicon. The second possibility is "lexical diffusion": a sound changes abruptly from a starting state to an ending state in some words at first, and this change gradually spreads through the lexicon. The third possibility is the Neogrammarian view: a sound changes the same way in all words of the lexicon simultaneously, but that