

# **Inhibitory Processes, Homophone Meanings Recognition, and Spoken Discourse Comprehension in Chinese**

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During last two decades, lexical ambiguity resolution has been the hot area for the investigation of context effects in word recognition (Onifer & Swinney, 1981; Swinney, 1979; Tanenhaus, Leiman, & Seidenberg, 1979; Tabossi, 1988; Simpson & Krueger, 1991; Sereno, 1995; Li & Yip, 1996; Zhang, Shu, & Zhang, 1997; Shu, Tang, Zhang, in press; Li, Shu, Yip, Zhang, & Tang, in press). For the purpose of distinguishing between interactive and modular theory, these investigations have been mainly focused on the meaning access of lexically ambiguous words in the very early stage of language comprehension. Few studies (especially in Chinese) have examined the fate of an inappropriate meaning after the selection of the appropriate meaning in discourse comprehension. In other words, for the unselected meaning, what will happen when one particular meaning of a homophone has been selected and enhanced by a sentence context? There are at least two possibilities (also see Gernsbacher & Faust, 1991). One is that the activation of the unselected meaning decays passively. The other possibility is that the inappropriate meanings are inhibited actively. Obviously, there is ecological validity for the second

possibility because inhibitory mechanisms are needed for the purpose of rapid and accurate comprehension.

Gernsbacher and Faust (1991) had provided very clear evidences demonstrating the role of suppression in sentence comprehension. They concluded that suppression could help fine tune the meanings of ambiguous words by decreasing the activation of the contextually inappropriate meanings. However, they did not investigate the question that whether or not the inhibitory mechanisms can sustain a long time. In other words, in their delayed condition, the test words were presented about 850 or 1000 ms after the appearances of homographs or homophones. Using a sentence-verification paradigm, Simpson and Kang (1994) found that inhibitory effects could sustain the duration longer than 1000 ms (in fact, the intervals between the two forms of a homograph were, on the average, more than 2 sentences). Notice that both Gernsbacher et al. and Simpson et al. did not manipulate the type of ambiguous words and the dominance of their inappropriate or irrelevant meanings. It is possible that whether the inhibitory mechanisms are necessary in the recognition of ambiguous word meanings is to some

degree related to both these factors. Moreover, on the basis of both studies mentioned above, one is not sure whether the inhibitory mechanism is a common or a specific one because only written (not spoken) sentences were used in both of them.

The issues here are whether we can obtain clear evidence of inhibitory mechanism contributing to the recognition of homophone meanings in spoken discourse comprehension and, more importantly, whether the necessity of this kind of mechanism is influenced by the type of homophones and/or dominance of irrelevant meanings. We used a cross-modal lexical decision paradigm to investigate these questions. In the repeated condition, participants listened to a discourse, which was coherent in meaning and composed of three sentences. One form of a disyllable Chinese homophone was presented in the first sentence, which highlighted one meaning of the homophone, and the other in the third sentence, which highlighted the other meaning of the same homophone. A visual disyllable Chinese word, which was presented just after the offset of the homophone in the third sentence and semantically related to the meaning of this homophone. The participants were asked to make lexical decision to the visual probe word. To make sure that participants listened to the discourse seriously, they were occasionally asked to make judgement about whether an auditory word was presented in the discourse they had just heard. An example was given below.

(a) Repeated condition

Spoken discourse:

“Zuo<sup>2</sup> wan<sup>3</sup> ta<sup>1</sup> qu<sup>4</sup> kan<sup>4</sup> le yi<sup>1</sup> chang<sup>3</sup> ping<sup>2</sup> ju<sup>4</sup>, shi<sup>4</sup> you<sup>2</sup> yi<sup>1</sup> ge<sup>4</sup> zhu<sup>4</sup> ming<sup>2</sup> yi<sup>4</sup> shu<sup>4</sup> jia<sup>1</sup> biao<sup>3</sup> yan<sup>3</sup> de, zhe<sup>4</sup> zhang<sup>1</sup> piao<sup>4</sup> ke<sup>3</sup> zuo<sup>4</sup> wei<sup>2</sup> ping<sup>2</sup> ju<sup>4</sup>.”

( 昨晚他去看了场评剧, 是由一个著名艺术家表演的, 这张票可作为凭据。)

Yesterday evening he watched a **Ping opera**, in which a famous artist gave a presentation. This ticket can give the **evidence**.)

Visual probe:

“证明”, zheng<sup>4</sup>ming<sup>2</sup>, proof

(b) Unrepeated condition

Spoken discourse:

“Zuo<sup>2</sup> wan<sup>3</sup> ta<sup>1</sup> qu<sup>4</sup> kan<sup>4</sup> le yi<sup>1</sup> chang<sup>3</sup> dian<sup>4</sup> ying<sup>3</sup>, shi<sup>4</sup> you<sup>2</sup> yi<sup>1</sup> ge<sup>4</sup> zhu<sup>4</sup> ming<sup>2</sup> yi<sup>4</sup> shu<sup>4</sup> jia<sup>1</sup> biao<sup>3</sup> yan<sup>3</sup> de, zhe<sup>4</sup> zhang<sup>1</sup> piao<sup>4</sup> ke<sup>3</sup> zuo<sup>4</sup> wei<sup>2</sup> ping<sup>2</sup> ju<sup>4</sup>.”

( 昨晚他去看了场电影, 是由一个著名艺术家表演的, 这张票可作为凭据。)

Yesterday evening he watched a **movie**, in which a famous artist gave a presentation. This ticket can give the **evidence**.)

Visual probe:

“证明”, zheng<sup>4</sup>ming<sup>2</sup>, proof

For the homophone in the first sentence in the example above, *opera* is appropriate meaning, while *evidence* was inappropriate meaning. The logic is, if the inappropriate meaning (e.g., *evidence*) is inhibited when the appropriate meaning (e.g., *opera*) has been selected, longer lexical decision latencies should be observed in the repeated condition than in the unrepeated condition. In the experiment reported here, homophone type, the dominance (i.e., the relative frequency) of the inappropriate meaning,

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<sup>1</sup> The pronunciations of Chinese words are given in Pinyin – the Chinese alphabetic system. Numbers following the Pinyin represent the tones of syllables.

and repeatedness were manipulated to explore the situations in which inhibitory mechanisms are necessary for the recognition of homophone meanings. Therefore, a 2(homophone type: balanced vs. biased)  $\times$  2(dominance: dominant vs. subordinate)  $\times$  2(repeatedness: repeated vs. unrepeated) design was used in the experiment here. All of them were within-subject factors, and only repeatedness was within-item factor.

Fifty-one undergraduate students (native Chinese speakers) participated in a pretest, where they were asked to write down as soon as possible the words they heard. One hundred and fifty homophones were included in this pretest. Among them, twenty-two balanced homophones (the relative frequencies of two different forms of homophones are close) and fifty-eight biased homophones (the relative frequencies of two different forms of homophones are quite different) were used in the cross-modal experiment. For these critical homophones, both the average numbers and the range of specific response of 51 subjects were given in Table 1.

Each homophone was embedded in two different spoken discourses with either two different forms in repeated condition or only one form in the unrepeated condition (see the example ahead). The visual probe words were always presented just after the offset of the homophones in the third sentences and always semantically related to the homophone meaning highlighted by those sentences. All the pseudowords were constructed with the characters presented in the true word.

Another thirty native Chinese speakers participated in the cross-modal experiment. Figure 1 and 2 showed the results for balanced and biased homophones respectively.

**Table 1. The Average Relative Frequencies of the Critical Homophone Meanings**

	Type of Homophones			
	Balanced		Biased	
	Dominant	Subordinate	Dominant	Subordinate
Dominance	Meaning	Meaning	Meaning	Meaning
Dominant	27 (23-32)	19 (14-24)	37 (29-44)	11 (6-16)
Subordinate	27 (19-34)	19 (15-24)	37 (26-45)	10 (5-16)

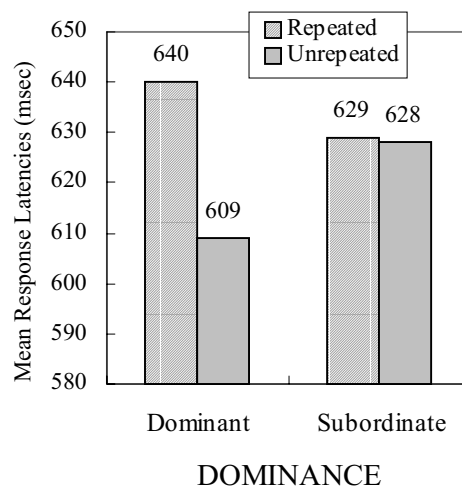


Figure 1. Mean response latencies as a function of repeatedness and dominance of the inappropriate meanings for balanced homophones.

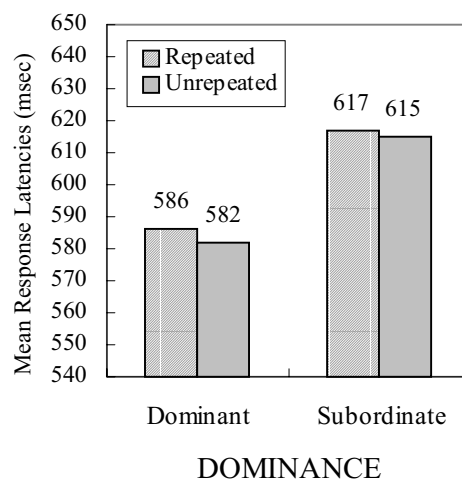


Figure 2. Mean response latencies as a function of repeatedness and dominance of the inappropriate meanings for biased homophones.

A 2(homophone type: balanced vs. biased)  $\times$  2(dominance: dominant vs. subordinate)  $\times$  2(repeatedness: repeated vs. unrepeated) analysis of variance (ANOVA) was

performed on the response latencies for the subjects (F1) and items (F2). The main effect of homophone type was significant by subjects,  $F(1, 29) = 18.23$ ,  $p < .001$ , and marginally significant by items,  $F(1, 76) = 3.54$ ,  $.05 < p < .10$ . The main effect of dominance was significant by subjects,  $F(1, 29) = 17.75$ ,  $p < .001$ , but not by items,  $F(1, 76) = 1.14$ ,  $p > .10$ . The main effect of repeatedness was not significant by subjects,  $F(1, 29) = 1.34$ ,  $p > .10$ , but marginally significant by items,  $F(1, 76) = 2.83$ ,  $.05 < p < .10$ . The interaction between homophone type and dominance was significant by subjects,  $F(1, 29) = 14.89$ ,  $p < .001$ , but not by items,  $F(1, 76) = 1.06$ ,  $p > .10$ . No other interactions were found,  $F < 1.0$  or  $p > .10$ .

We noted that the largest effect of repeatedness was found for the balanced homophones under the dominant condition, i.e., the inappropriate meanings were their dominant meanings (see Figure 1 and 2). Therefore, separate post-hoc analyses were conducted on the differences between repeated and unrepeated condition, for both two types of homophones under both dominant and subordinate condition. The analysis showed significant repeatedness effect only for balanced homophones and only when the inappropriate meanings were their dominant meanings,  $F(1, 76) = 4.01$ ,  $p < .05$ , although the effect failed to reach significance by subjects,  $F(1, 29) = 1.86$ ,  $p > .10$ . Longer decision latencies were observed in the repeated condition than in the unrepeated condition (31 ms differences between the two conditions). All these results suggested that the inhibitory mechanism would have effect only when it is necessary. For balanced homophones, there is conflict between their two alternative meanings. The effect of the conflict on discourse comprehension is stronger when the dominant meanings are

inappropriate than when the subordinate meanings are inappropriate. Thus, when the dominant meanings of balanced homophones are inappropriate, they will be inhibited and most importantly, the inhibitory mechanism can sustain a relatively long time. However, for biased homophones, there is little conflict between their two different meanings. Therefore, even when the dominant meanings of those biased homophones are inappropriate, the inhibition to them will decrease rapidly.

## References

- Gernsbacher, M. A., & Faust, M. (1991). The role of suppression in sentence comprehension. In Simpson G B (Ed.) *Understanding word and sentence* (pp. 97-128). Elsevier Science Publishers.
- Li, P., & Yip, M. C. (1996). Lexical ambiguity and context effects in spoken word recognition: Evidence from Chinese. In Cottrell G (ed.), *Processing of the 18th annual conference of the cognitive science society* (pp. 228-232). Lawrence Erlbaum Associates, Mahwah, NJ.
- Li, P., Shu, H., Yip, M., Zhang, Y., & Tang, Y. (in press). Lexical ambiguity in sentence processing: Evidence from Chinese. In M. Nakayama (ed.) *Crosslinguistic Sentence Processing*. Stanford, CA: Center for the Study of Language and Information Publications.
- Onifer, W., & Swinney, D. A. (1981). Accessing lexical ambiguities during sentence comprehension: Effects of frequency of meaning and contextual bias. *Memory and Cognition*, *9*, 225-236.
- Sereno, S. C. (1995). Resolution of lexical ambiguity: Evidence from an eye movement priming paradigm. *Journal of Experimental Psychology: Learning*,

- Memory, and Cognition*, 21, 582-595.
- Shu, H., Tang, Y., & Zhang, Y. (2000). A study on the resolution of lexical ambiguity of two-syllable homophones in Chinese. *Acta Psychologica Sinica*, 32, 247-252.
- Simpson, G. B., Kang, H. (1994). Inhibitory processes in the recognition of homograph meanings. In Dagenbach D and Carr T H (Eds.) *Inhibitory processes in attention, memory, and language* (pp. 359-381). San Diego: Academic Press.
- Simpson, G. B. (1981). Meaning dominance and semantic context in the processing of lexical ambiguity. *Journal of Verbal Learning and Verbal Behavior*, 20, 120-136.
- Simpson, G. B., & Krueger, M. A. (1991). Selective access of homograph meanings in sentence context. *Journal of memory and Language*, 30, 627-643.
- Swinney, D. A. (1979). Lexical access during sentence comprehension: (Re)consideration of context effects. *Journal of Verbal Learning and Verbal Behavior*, 18, 645-659.
- Tabossi, P. (1988). Accessing lexical ambiguity in different types of sentence contexts. *Journal of memory and Language*, 27, 324-340.
- Tanenhaus, M. K., Leiman, J. M., & Seidenberg, M. S. (1979). Evidence for multiple stages in the processing of ambiguous words in syntactic context. *Journal of Verbal Learning and Verbal Behavior*, 18, 427-440.
- Zhang, Y., Shu, H., & Zhang, H. The time course of meaning access of homographs in Chinese sentence reading. The 2nd Chinese Psychologists Conference, Hong Kong, December, 1997.