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# Grammaticality judgment in Chinese-English bilinguals: A gating experiment

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## Abstract

An on-line gating method was used to investigate Chinese-English bilinguals' performance in a grammaticality judgment task. Evidence of different transfer patterns (i.e., *backward* and *forward* transfer in early and late second language acquisition) was found in the data reported here. There were strong and systematic relations between performance on the judgments of grammaticality and a separate sentence interpretation task. However, there is also some evidence that inter-language transfer or interference occurs earlier in acquisition for the judgment task than for the sentence interpretation. Judgments of well-formedness might be one of the first domains to "soften" when one language comes into contact with another. Furthermore, it is possible that Chinese and English are more "inter-penetrable" for both forward and backward transfer between these two languages than has been observed between any two language types to date.

## Introduction

Cross-linguistic studies of monolinguals have revealed dramatic differences in the processing strategies that native speakers use to interpret sentences, reflecting differences in the relative information value of lexical and grammatical cues in each language. Drawing on results from studies of sentence processing in a large number of different languages, Bates and MacWhinney (1982, 1989) have constructed a model of sentence processing, known as the Competition Model, to emphasize the extent to which languages can vary in the way that cues compete and converge to determine meaning. A cue, in this context, is a particular piece of information that a speaker

or listener can use to determine the relationship between meaning and form. The Competition Model assumes an interactive process in which the mapping between surface forms and underlying meanings is mediated by competitions and collaborations among cues. Cues can be evaluated with respect to their validity, i.e., their information value for the identification of linguistic functions. In any given language, the overall validity of a cue is a joint product of its availability (how often the cue is present when a given interpretation has to be made) and its reliability (when the cue is available, how often it leads to the right answer). Having different cue validities, different cues cooperate and compete in the comprehension process, resulting in different interpretation patterns in different languages.

Most previous studies within the Competition Model have adopted a sentence comprehension task in which native speakers of different languages are presented with simple sentences in their own languages and are asked to identify the agent (actor) of the sentence. In the sentence *The pencil is kissing the elephant*, for example, native English speakers choose the "pencil" as the agent much more often than the "elephant" while native Chinese speakers show the opposite strategy, choosing "elephant" as the actor regardless of word order (Bates & MacWhinney, 1989; Miao, 1981). This finding is compatible with the cue validity principle, because Chinese permits far more word order variation than English, and because the sentence subject (and object) can be omitted in free-standing declarative sentences. Hence word order information is a very strong cue to the agent role in English, but not as strong as animacy in Chinese.

The finding that processing strategies differ

markedly across language types opens up a series of questions concerning the performance of bilingual individuals in each of their languages. Researchers working within the framework of the Competition Model have described four logically possible outcomes that we might expect to find in adult bilinguals: 1) "forward transfer", transfer of the first language strategies in the interpretation of sentences into the second language; 2) "backward transfer", transfer of the second language strategies into the first language; 3) "differentiation", adoption of different strategies for the two languages corresponding to the strategies used by monolingual speakers of each language; 4) the use of a new set of "amalgamated" strategies by bilinguals to both of their languages, which is different from the strategies used by either group of monolingual speakers. All of these patterns have been observed in at least some individuals (Kilborn, 1989; McDonald, 1987). Because they suggest "degrees" of transfer, in more than one direction, they are difficult to explain without invoking the kinds of quantitative, interactive activation principles provided in the Competition Model.

Prior to the study reported here, we conducted a sentence interpretation task to examine the patterns of transfer displayed by Chinese-English and English-Chinese bilinguals (Liu, Bates, & Li, in press). The results showed that novice bilinguals display strong evidence for forward transfer (Chinese-English novices transfer animacy-based strategies to English sentences; English-Chinese novices transfer English-like word order strategies to Chinese). Advanced bilinguals display a variety of transfer patterns, including differentiation (use of animacy strategies in Chinese and word order strategies in English) and backward transfer (i.e., use of L2 processing strategies in L1 – a possible symptom of language loss). These findings were shown to reflect a complex interaction of variables including age of exposure to L2 and patterns of daily language use.

So far, all the bilingual work within the Competition Model has focussed on sentence comprehension, raising concerns for the generalizability of these complex bilingual findings. The present study will examine bilingual processing in a different domain, i.e., grammaticality judgment. By combining results from the judgment and the interpretation tasks, we can learn more about the nature of inter-language transfer, in particular

the process by which first language strategies "invade" second language strategies (and vice versa).

## Method

In this experiment, a sentence-level "gating" method was used to evaluate judgments of grammaticality for Chinese sentences. This gating task was modeled after the well-known word-level gating paradigm pioneered by Grosjean (1980) and by Marslen-Wilson and Tyler (1980). In the word-level gating task, subjects hear increasingly long fragments of a word, starting with the first fragment (e.g., "S—", followed by a slightly longer fragment (e.g., "ST—"), with progressive expansion on each trial until the subject indicates that he is now sure of the identity of the word (e.g., "STRING"). In our sentence-level adaptation of the gating task, subjects were asked not to guess the identity of the sentence (an impossible task, since the set of sentences in any language is infinite), but to determine whether the sentence is grammatical SO FAR, starting with the first constituent in the sentence, with progressive expansion until the whole sentence has been presented.

**Subjects.** 33 subjects (19 male and 14 female adults ranging in age from 19 to 44 years) who had participated in sentence comprehension tests in our previous study (see Liu et al., in press) were brought into an on-line Chinese grammaticality judgment task. They were divided into 5 groups: 1) controls – monolingual native speakers of Chinese who had been exposed to English speaking environment for no more than half a year and had received little or no formal training in English when they were in China; 2) native Chinese who were novices in English, with their first exposure to English occurring after 20 years of age; 3) native Chinese who were more advanced in English, with age of first exposure before 20 years of age; 4) native English speakers who were novices in Chinese, and were first exposed to Chinese after 19 years of age; 5) native English speakers who were advanced in Chinese, and were exposed to Chinese from early childhood.

**Procedure.** The three possible judgments of grammaticality, i.e., "grammatical", "ungrammatical" or "don't know", were represented by three buttons on a button box. Chinese sentences were presented auditorily, ONE PORTION at a

time. Each sentence portion was read by a native speaker in a smooth and flat intonation and then digitized into the computer. For example, if the sentence is (the Chinese equivalent of) *The cow kick the horse*, subjects would hear the following in sequence and need to push one of the buttons for their judgments at each point: *The cow*, *The cow kick*, *The cow kick the horse*. All the sentence types were counterbalanced across word order and noun animacy, which yielded the following types of sentences: AVA, AVI, IVA, VAA, VAI, VIA, AAV, AIV, IAV.

**Data Analysis.** Scoring of the dependent variable was based on the rating of the grammaticality of the phrases. For each phrase, subjects were given a score of 3 for rating the phrase as *grammatical*, a score of 2 for rating the phrase as *unsure*, a score of 1 for rating the phrase as *ungrammatical*. These values were entered as the raw data for subsequent statistic analysis.

## Results and Discussion

Although data are available from a broader range of sentence types, we will simplify the present discussion by focusing on the results from sentences that follow canonical word order NVN, under different animacy conditions (Animate-Verb-Inanimate or AVI sentences like *The cow kick the pencil*; Inanimate-Verb-Animate or IVA sentences like *The pencil kick the cow*; semantically neutral Animate-Verb-Animate or AVA sentences like *The cow kick the horse*).

Control data from monolingual Chinese speakers indicate that when word order was consistent with animacy (e.g., AVI items), subjects considered the sentence to be grammatical at all three judgment points: N, NV, and NVN. When there was a competition type between semantics and word order (e.g., IVA items, see Figure 1), subjects would accept the first inanimate noun as grammatical (averaged rating score = 2.83). However, they began to judge the sentence as ungrammatical after IV (averaged rating score = 1.64), and reject it still further at the end (averaged rating score = 1.47). In short, although these monolingual Chinese reliably interpret IVA strings as Object-Verb-Subject (OVS), the judgment task shows that they do not like OVS structures at all, rejecting them as possible structures in their language. ANOVA results show that all

the analyses in the control group reached significance, including word order ( $F(2,12) = 14.4$ ,  $P < 0.001$ ), animacy ( $F(2,12) = 50.8$ ,  $P < 0.001$ ), position ( $F(2,12) = 31.0$ ,  $P < 0.001$ ), and two-way as well as higher-level interactions ( $P < 0.001$ ).

The results from our four bilingual groups are also illustrated in Figure 1, where we focus once again on IVA (although a similar story emerges on other sentence types). The most important result was an inverse relationship between sentence interpretation strategies (from animacy-dominance in Chinese to word order dominance in English) and judgments of grammaticality. Ratings of grammaticality for these competition items increase significantly as we move away from our animacy-dominant monolingual Chinese group to our word-order-dominant English-Chinese novices. The difference between the two extreme groups, i.e., the most Chinese group (control group) and the most English group (novice English-Chinese), reached significance ( $F(1,12)=252$ ,  $P < 0.001$ ). To illustrate, consider the strongest competition cell (IVA, as in *The rock hit the cow*). Chinese-dominant bilinguals use semantics to make their interpretation (i.e., *the cow did it*, see Liu et al., in press). This is a semantically plausible reading, but it also means that the sentences has been interpreted as an OVS. OVS is an impossible structure in the Chinese language – a fact that is reflected in left-to-right grammaticality judgments offered by these subjects. English-dominant bilinguals rely on word order to make their interpretations (i.e., *the rock did it*). This is a semantically implausible reading, but it preserves SVO structure. This fact is also reflected in the left-to-right grammaticality judgments made by English-dominant bilinguals, who judge strings like *The rock hit the cow* to be perfectly grammatical.

These findings suggest that forward and backward transfer strategies observed in the sentence interpretation task also have implications for judgments of grammaticality. Particularly strong support for this view comes from those bilingual subjects who stand somewhere “in between” in their use of semantics and word order to interpret sentences. Many of these subjects also display a grammaticality judgment pattern that is “in between”, showing a great deal of uncertainty regarding the grammaticality of competition strings. For other Chinese-English

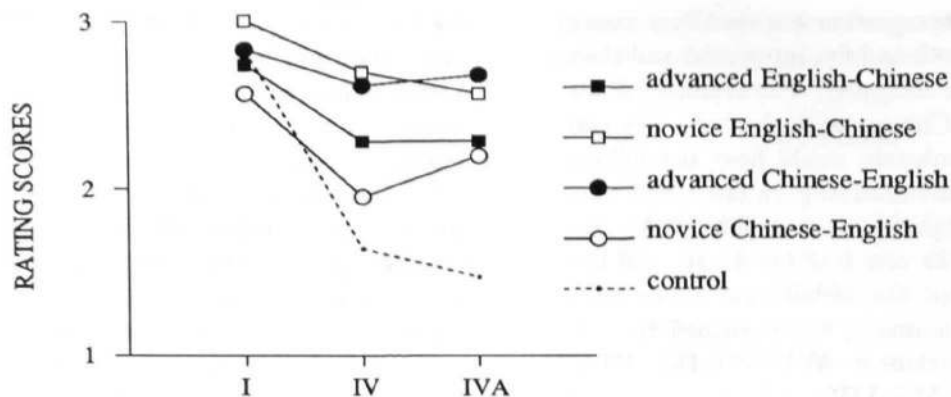


Figure 1: Judgment of grammaticality of IVA sentences

bilinguals, a comparison of the interpretation and judgment tasks suggests that “backward transfer” (i.e., invasion of Language 1 by Language 2) may show up in grammaticality judgments before it appears in sentence interpretation. That is, some of our “in between” subjects (e.g., novice Chinese-English subjects) experience great uncertainty in the judgment task (with judgments persisting in the “don’t know” range across the course of the sentence), even though they still display a native-like preference for animacy strategies in the interpretation task.

### Summary and Conclusion

One of the main results in the sentence gating task is that novice Chinese-English subjects tend to think that the IVA sentences like *The pencil hit the cow* are relatively LESS grammatical than novice English-Chinese bilinguals. This result maps directly onto results from the comprehension task, where novice Chinese-English subjects show animacy dominance (interpreting IVA strings as semantically plausible but grammatically unacceptable OVS) while novice English-Chinese subjects show word order dominance (interpreting IVA strings as “silly” but grammatically acceptable SVO). In other words, these subjects distinguish very clearly between grammaticality (which is about the well-formedness of sentences) and plausibility (which is about how well the apparent meaning of the sentence fits the real world).

This finding is consistent with Bates et

al. (1982)’s interview with English-dominant English-Italian bilinguals, i.e., English subjects interpret a sentence like *the rock kiss the cow* as grammatical but “silly”, and they choose the “rock” as the actor. Their Italian-dominant bilinguals report that such sentences are both grammatical and semantically plausible. Chinese is more or less like Italian in the sense that the animacy cue is stronger than word order, but they differ because OVS is a possible (albeit infrequent) structure in Italian while the same order is not possible in Chinese – and yet the Chinese do not “trust” any word order cue enough to override semantics.

A comparison of the interpretation and the judgment tasks also provides interesting information about degrees of “backward” and “forward” transfer. In particular, some of our bilingual subjects display an “in-between” pattern, in both the interpretation and the judgment task. Others show a “softening” of grammaticality judgments while they are still actively using strategies from their first language for sentence interpretation. That is, bilingual speakers may begin to lose sensitivity to the well-formedness of sentences in their first language, even though they are still processing sentences in the normal way.

Finally, the sentence-level gating task provides interesting information about the point at which judgments of grammaticality are made. A comparison of the different bilingual groups in Figure 1 shows that their decisions diverge at the point where a contrast between OVS and SVO becomes clear. However, for those bilingual sub-



jects who are "in between", uncertainty begins at that very same point and persists across the sentence. Evidence from several other sentence types in our data set leads to a similar conclusion. These "in between" patterns of forward and backward transfer are compatible with the interactive activation principles of the Competition Model, and may lead to a deeper understanding of the quantitative and qualitative processes that underlie inter-language transfer.

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