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Context effects on sentence processing: A study based on the Competition Model

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ABSTRACT
Based on the Competition Model, the present study investigated how adult monolinguals and bilinguals incorporate the context cue in assigning the agent role vis-à-vis intrasentential cues (animacy and word order). The subjects were L1 and L2 speakers of Chinese and English. The results show that both Chinese and English monolingual controls paid less attention to context than to intrasentential cues that have been identified as determinants for Chinese and English sentence processing. Nevertheless, context was found to play a bigger role in Chinese than in English. As for L2 learners, the main effect of context was significant in all groups of learners of Chinese and English. However, the Chinese EFL learners relied on context to a greater extent than did the English CFL learners when processing their respective L2.

In recent years, there has been much psycholinguistic research done within the framework of Bates and MacWhinney's Competition Model to investigate how L1 and L2 speakers of a given language use surface cues (e.g., word order, animacy, case marker, verb agreement, etc.) to determine the agent–patient or subject–object relation in a sentence (Bates, McNew, MacWhinney, Devescovi, & Smith, 1982; Kail, 1989; Li, Bates, Liu, & MacWhinney, 1993; McDonald, 1987; Mimica, Sullivan, & Smith, 1994; Sasaki, 1994; Su, 1995, 1998; Taman, 1993). Most of the studies employed a sentence interpretation task in which subjects were required to identify the agents ("who does it?") in simple active transitive sentences with certain cues in competing or converging combinations. The major findings on adult L1 sentence processing are that surface cues are not equally used in a given language and that, across languages, a cue that is strong in one language may be weak in another. For example, MacWhinney, Bates, and Kliegel (1984) compared the processing strategies employed by English, German, and Italian monolinguals. They found that English monolinguals relied on the word order cue, followed by verb agreement and animacy; Italian monolinguals depended on the verb agreement cue, followed by animacy and word order; and German monolinguals relied on a combination of animacy

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and agreement. Thus, the surface cue that is used most often by English listeners in interpreting English sentences is the least important source of information in Italian sentence processing.

According to the Competition Model, cross-language variation in reliance on cues can be predicted and accounted for by differences in cue validity. The validity of a cue is defined in terms of two parameters: availability and reliability. Availability refers to the frequency of occurrence of a particular cue; if a cue is always present in a sentence whenever it is needed, then it is maximally available. Reliability is defined as the percentage of times that a cue leads to the correct interpretation when the cue is available. Validity is defined as the product of availability times reliability.[1] For example, both word order and animacy cues are available in English and Italian, but their validities are different, and so the strength assigned to each cue differs. In English, except in passive sentences, the position of a noun before and after a transitive verb is both a highly available and highly reliable cue to the agent–patient (subject–object) relation, leading English monolinguals to rely on the word order cue in interpreting sentences. However, Italian allows a great deal of word order variation for pragmatic purposes. As a result, word position is neither available nor reliable for Italian monolinguals in determining the meaning of a sentence. On the other hand, verb agreement is always available and reliable, since the language has a rich verbal morphological system.

Extrasentential cues in assigning semantic roles

Studies of sentence interpretation within the Competition Model framework have examined the various surface cues (e.g., word order, animacy, case marker, verb agreement, etc.) that people use when determining semantic roles. Among these studies, only a few have included extrasentential factors and investigated how those cues come into play vis-à-vis intrasentential cues in people's comprehension of simple sentences. The extrasentential cues that have been explored are contrastive stress (Bates et al., 1982; MacWhinney et al., 1984) and topicalization (Bates et al., 1982; Gass, 1987). MacWhinney et al. (1984) tested and compared how L1 listeners of English, German, and Italian incorporated intrasentential cues (word order, verb agreement, noun animacy) and an extrasentential factor (stress) in assigning the agent role. They found that, overall, listeners of these languages paid less attention to stress than to intrasentential cues in deciding agent–patient relations. Nevertheless, comparing the languages, stress was found to play a bigger role in German and Italian (both languages permit variation in word order for pragmatic purposes). Stress was reported to have an impact in Italian processing when the most important cue (i.e., verb agreement) was unavailable, even for basic NVN strings. SVO interpretations dropped from 85% to well under 70% when either the first or second noun was stressed. German listeners were found to rely on stress when the verb agreement cue was ambiguous or when the agreement and word order cues were in competition; in the latter case, the conflict was partially resolved by stress. However, contrary to Italian processing, stress had very little effect on canonical NVN order for German listeners, even when the morphological cue was unavailable (i.e., the

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SVO interpretation dominates). In contrast to Italian and German processing, stress was not effective at all in English processing; none of the effects involving stress reached statistical significance.

Gass (1987) examined the topic cue as well as word order and animacy in the processing of English and Italian by second and foreign language learners of the two languages (i.e., ESL, EFL, ISL, IFL). One of the two nouns in the test sentence was topicalized by the phrase "as far as *X* is concerned" and preceded the target sentence (e.g., *As far as the goat is concerned, the goat the cow kicks*). The results revealed that the variable of topic had less influence overall than the other variables, and that topic was least important in NVN order for all learner groups. In other words, SVO order was more important than topic. For noncanonical NNV and VNN orders, the differences among the four groups were not great, with all groups choosing the topicalized noun to some extent.

Another important extrasentential factor that has not yet been explored in the Competition Model studies is sentential context. Some psycholinguistic studies have suggested that context plays only a small role in a sentence interpretation, and that some privilege is given to information contained within the sentence, particularly syntactic information (e.g., Ferreira & Clifton, 1986; Fodor, 1983; Foster, 1979; Holmes, 1984). Holmes (1984), for example, investigated whether the preferred interpretation of sentences with ambiguous surface structure would be altered when the sentences were understood in the light of a prior context. After identifying the syntactic strategies that the subjects used in interpreting isolated sentences, the author added context before each ambiguous sentence. Consider, for example, *The teacher taught the children to draw with care*, where the adverbial phrase *with care* could be attached either to *draw* or *taught*. Results showed that, despite the ambiguity, the subjects preferred to link the adverbial phrase to the lowest verb phrase in the surface structure rather than to a higher one (e.g., *draw* rather than *taught*). The meaning of the context was slanted either to the structurally preferred or the structurally nonpreferred reading: preferred, *Even though she was rather casual and impatient with some of the children, the teacher managed to teach them to produce quite careful drawings*; nonpreferred, *Even though the children's drawings were often sloppy and careless, she showed a great deal of patience in teaching them*. The results revealed that contexts were relatively ineffective in modifying syntactic preferences (e.g., given the nonpreferred context, the subjects still interpreted the target sentence according to the syntactic strategy). The author thus concluded that the structure that is assigned to the ambiguous sentence is chosen independently of prior contextual information.

Hargrove and Panagos (1982) tested the comprehension of active and passive sentences by English-speaking children at four different ages (3, 4, 5, and 7 years). The sentences were preceded by matching, mismatching, or no information. Their results showed that, as children became older and more familiar with the syntactic structures, they paid less attention to the information provided by context. Whereas 3-year-old children responded to active and passive enactment sentences according to preceding context, 4- and 5-year-olds appeared to be not affected by context when enacting active sentences; 7-year-olds attended to the

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syntactic rules when enacting both active and passive sentences, but seemed to be insensitive to conflicts between context and syntax. The authors concluded that children make use of contextual information when they do not understand a syntactic structure. As children begin to learn the structure, they depend less on contextual information.

Although studies have found that context has little effect in sentence interpretation, the conclusion has to be considered tentative because the majority of research so far has focused on the English language, which makes it difficult to know whether this is true for all languages. More cross-linguistic data are surely needed before we may reach such a conclusion.

Research questions

Sentence comprehension studies based on Bates and MacWhinney's Competition Model have shown that Chinese native speakers pervasively rely on the animacy cue to interpret simple declarative sentences in isolation (Li et al., 1993; Miao, 1981; Su, 1995). They tend to select the animate noun as the agent, regardless of word order conditions. On the other hand, English native speakers overwhelmingly depend on the word order cue in processing their L1 (Bates et al., 1982; Su, 1998). They consistently choose the first noun in canonical NVN strings and the second noun in NNV and VNN sentences as the doer of the action, irrespective of animacy contrasts. Two sets of research questions were thus addressed in the present study:

1. What role does discourse context play vis-à-vis intrasentential cues (e.g., word order and animacy) in Chinese and English L1 sentence processing? Does context "win" whenever it is in conflict with intrasentential cues that have been identified as determinants for Chinese or English sentence processing? Do Chinese and English controls depend on the context cue to the similar degree?
2. Do language learners rely on sentential context to a greater extent than do controls when comprehending an L2? Does the degree of reliance on the context cue change as a function of proficiency? Is there any difference between EFL and CFL learners in their use of the context cue in L2 processing?

METHOD[2]

Subject

A total of 122 people participated in the study. The subjects were divided into two main groups: Chinese native speakers and English native speakers. In each group, the subjects were assigned to one of four subgroups: one group of controls and three groups of language learners varying in their level of proficiency in the L2 (beginning, intermediate, and advanced). Thus, there were eight groups of subjects in total; except for the Chinese and English control groups ($n = 16$), each group consisted of 15 people.

The Chinese subjects were recruited in Taipei. The Chinese controls were Taiwan Mandarin speakers who were students in a vocational school and knew

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little English (average age: 17 years). The beginning learners were students at a private language center who had studied English for 2 to 3 years. The intermediate learners were English majors in their first year at college who had studied English for about 6 years. The advanced subjects were professors or instructors of English universities in Taipei who had studied English for 10 years in Taiwan and had a master's or doctorate degree in English literature or ESL from a university in the United States.

The English subjects were recruited in Honolulu, Hawaii. The English controls were undergraduate or graduate students at the University of Hawaii at Manoa who did not know Chinese and were not familiar with any other languages. The beginning learners were students in Chinese 202 who had studied Chinese for about 2 years. The intermediate learners were senior undergraduate or graduate students in Chinese or Asian Studies who had studied Chinese for 5 to 6 years. The advanced subjects included professors or instructors of Chinese, Chinese history, or Asian studies who had been in China or Taiwan for 3 to 4 years.

Test sentences

The cues tested in the present study were word order, noun animacy, and discourse context. There were three different word order types: verb-medial (NVN), verb-initial (VNN), and verb-final(NNV). Animacy was varied on three levels; the two nouns were animate–animate (AA), animate–inanimate (AI), or inanimate–animate (IA). The target sentences were composed of two nouns and one transitive verb. All possible combinations of two nouns and one verb were presented, resulting in nine sentences types (3 Word Order × 3 Animacy): AVA, AAV, VAA; AVI, AIV, VAI; IVA, IAV, VIA. There were three trials for each sentence type, resulting in 27 target sentences.

The contextual sentences were constructed to favor either first-noun interpretation (N1) or second-noun interpretation (N2). Table 1 presents some examples of the test stimuli. Given that the vocabulary of beginning L2 learners is limited, each contextual sentence was a short clause with less than 5 simple words. For example, contextual sentences that favor first-noun and second-noun interpretations of the target sentence *The rabbit bites the tiger* would be *The rabbit is angry* and *The tiger is hungry*, respectively.[3] There were also 18 filler contextual sentences, representing each type of test stimulus (3 Animacy × 3 Word Order × 2 Context). These were created so that the subjects would not find any consistent pattern between the preceding context and the following target sentence that they could use to assign the agent role, without paying attention to the meaning. The filler sentences were constructed so that each filler mentioned one of the nouns in the target sentence, but the meaning of the filler was not informative as to "who does the action" in the target (e.g., *the rabbit likes carrots; the rabbit the door bumps*. In total there were 72 contextual sentences. Both Chinese and English sentences were created; the English sentences were translations of the Chinese ones. Each English sentence consisted of a verb in the third person singular and two nouns with the definite article *the*. All of the test stimuli were tape-recorded with neutral intonation; the stimuli are listed in Appendices 1 (Chinese) and 2 (English).

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Table 1. *Examples of test stimuli*

Animacy	Word order	Discourse context	Target sentence
Stimuli			
AA	NVN	N1 Tuzi shenqi le. N2 Laohu duzi er.	Tuzi yao laohu.
AI	NNV	N1 Houzi zai pao. N2 Pingguo gun xialai.	Houzi pingguo zhuang.
IA	VNN	N1 Damen zai yaohuang. N2 Shizi zai wan.	Tui damen shizi.
AA	NVN	N1 The rabbit is angry. N2 The tiger is hungry.	The rabbit bites the tiger.
AI	NNV	N1 The monkey is running. N2 The apple is rolling.	The monkey the apple bumps.
IA	VNN	N1 The door is swinging. N2 The lion is playing.	Pushes the door the lion.
Fillers			
AA	NVN	N1 The girl is 12 years old.	The girl grabs the boy.
AI	NNV	N2 The apple is green.	The monkey the apple bumps.
IA	VNN	N1 The door is black.	Pushes the door the lion.

Procedures

The English and Chinese controls were tested in their respective L1; the L2 learners were tested in their respective L2. Each subject was provided with an answer sheet on which the two nouns for each target sentence were written, and she or he was instructed to circle the noun that did the action in the sentence. During the tests, it was first ascertained that the L2 subjects understood the L2 vocabulary items. This was accomplished by giving each subject a list of the words used in the task to review a few days before the test and asking them to translate each of the words into their L1 on the day of the test. Before the test began, I explained the task to the subjects in their L1. It was stressed that some sentences might sound strange or ungrammatical, but they still had to select one of the two nouns as the actor. It was also made clear that there were no right or wrong answers, and that it was their first impression of the meaning of the sentence that was of interest. Three practice sentences were given to subjects before the test using lexical items different from those in the test.

Scoring

Scoring generally followed the procedure adopted in previous studies to derive the dependent variable, percentage choice of first noun as agent. Each subject's response was given a score of 1 if the first noun was chosen and 0 if the second noun was chosen.

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RESULTS AND DISCUSSION

The data for each group of subjects were analyzed in a $3 \times 3 \times 2$ (Animacy × Word Order × Context) ANOVA repeated measure. This design was extended to include a between-subjects factor when comparing the performances of the two control groups or the performance of a learner group to that of a control group. The significance level was set at .01.[4] Following MacWhinney et al. (1984), in addition to significance levels for each factor and interaction, the percentage of experimental variance accounted for by each cue is also reported to show the relative strength with which it is used.

The primary interest of this study is to investigate how L1 and L2 speakers of Chinese and English incorporate discourse context (extrasentential factor) into their processing of simple declarative sentences vis-à-vis animacy and word order (intrasentential factors). Accordingly, the following report of the results focuses on the main effect of context and its interaction with the intrasentential cues. The main effects of animacy and word order are reported only to make a comparison with the effect of context, especially in terms of the percentage of variance each effect accounts for. The interaction between animacy and word order in each group is not discussed, as it is not of interest in the present study.[5]

Context effects in the monolingual controls

English native speakers. A $2 \times 3 \times 3 \times 2$ (Group × Animacy × Word Order × Context) ANOVA comparing English and Chinese controls on their use of the three cues in sentence processing revealed significant differences: Group × Animacy, $F(2, 60) = 18.74$, $p \leq .0001$; Group × Word Order, $F(2, 60) = 82.68$, $p \leq .0001$; Group × Context, $F(1, 30) = 12.81$, $p \leq .01$. However, none of the three-way or four-way interactions were significant. Table 2 presents the ANOVA results for the English and Chinese controls on their performance in their respective L1. As seen in the table, the syntactic cue (word order) was the most important factor in the English controls' interpretation of their L1, $F(2, 30) = 157.81$, $p \leq .0001$, accounting for 94% of the experimental variance. The main effect of context was not significant, $F(1, 15) = 5.18$, $p = .04$, *ns*); the first noun was chosen at a similar rate in both context conditions (50% vs. 42%). None of the two-way or three-way interactions involving context reached significance. Figure 1 illustrates the interaction of Word Order × Context in the English controls' interpretation of English. It is obvious that these subjects strongly relied on word order strategies, assigning the agent role to the first noun in canonical NVN order (e.g., choosing *the rabbit* as the agent in the target sentence *the tiger is hungry; the rabbit bites the tiger*) and to the second noun in noncanonical NNV and VNN orders (e.g., choosing *the cat* as the agent in the target sentence *the dog is mad; the dog the cat kicks* or selecting *the pig* as the agent in the target sentence *the cow is playing; grabs the cow the pig*), without paying attention to discourse information: Word Order × Context, $F(2, 30) = 2.38$, $p = .1$, *ns*.

To examine the effect of context, I plotted the subjects' choice of first noun in contexts favoring the first or second noun across sentence types (Figure 2).

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Table 2. *ANOVA results for English and Chinese native speakers*

Group and effect	*df*	*F* ratio	$p \leq$	Variance
English native speakers				
Animacy	2, 30	12.87	.0001	3%
Word order	2, 30	157.81	.0001	94%
Context	**1, 15**	**5.18**	***ns***	**—**
Animacy × Word Order	4, 60	3.44	*ns*	—
Animacy × Context	2, 30	<1	*ns*	—
Word Order × Context	2, 30	2.38	*ns*	—
Animacy × Order × Context	4, 60	<1	*ns*	—
Chinese native speakers				
Animacy	2, 30	48.02	.0001	63%
Word order	2, 30	2.60	*ns*	—
Context	**1, 15**	**34.34**	**.0001**	**29%**
Animacy × Word Order	4, 60	5.25	*ns*	—
Animacy × Context	2, 30	4.24	*ns*	—
Word Order × Context	2, 30	<1	*ns*	—
Animacy × Order × Context	4, 60	<1	*ns*	—

Note: Lines in boldface indicate significant effects.

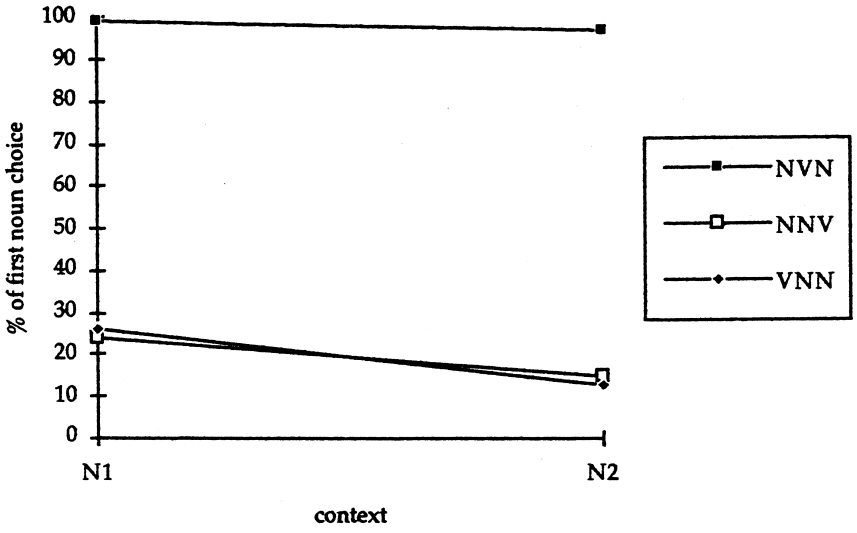


Figure 1. Percentage of first-noun choice as a function of Word Order × Context in the English native speakers.

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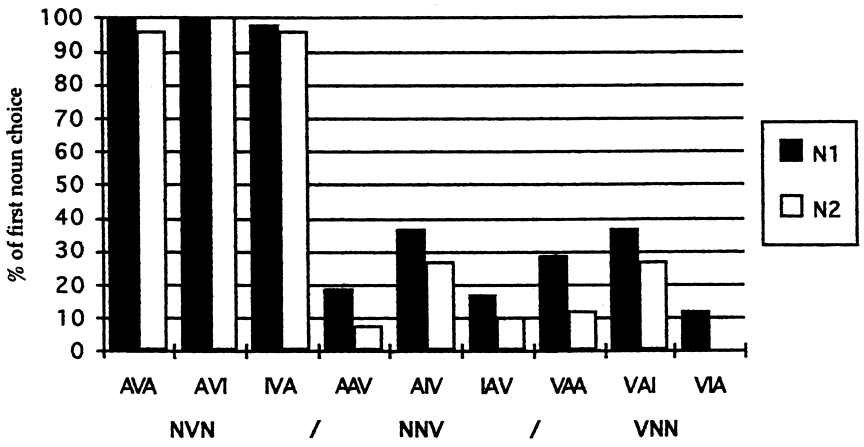


Figure 2. English native speakers' choice of first noun under different context conditions.

The sentence types were arranged into three groups on the basis of word order: canonical NVN strings (AVA, AVI, IVA), noncanonical NNV strings (AAV, AIV, IAV), and noncanonical VNN strings (VAA, VAI, VIA). As seen in the figure, the difference in the percentage of first-noun choice under the different context conditions is small across word order types in the English controls' performance. The effect of context is weakest for canonical NVN strings. The choice of first noun was close to the ceiling even in the IVA-N2 cell (96%), where context allied with animacy against SVO order (e.g., *the balloon* was chosen as the agent most of the time in the target sentence *the monkey is naughty; the balloon pulls the monkey*). More surprisingly, even for noncanonical NNV and VNN orders, the second-noun strategy overrode the combined influence of context and animacy. For instance, in the AIV-N1 cell, where both animacy and context suggest that the first noun did the action (e.g., *the mouse is playing; the mouse the window pushes*), the English controls chose the second noun as the actor above the chance level (63% of the time).

Chinese native speakers. Among the three cues, the Chinese controls exhibited the greatest preference for the semantic cue (noun animacy) in processing their L1, $F(2, 30) = 48.02$, $p \leq .0001$, accounting for 63% of the experimental variance (see Table 2). Discourse context also played an important role in L1 processing, $F(1, 15) = 34.34$, $p \leq .0001$, accounting for 29% of the experimental variance. Across all animacy and word order conditions, the first noun was chosen 71% of the time when context favored the first noun and 40% of the time when context favored the second noun. As for the interaction of Animacy $\times$ Context, the effect was close to significance $F(2, 30) = 4.24$, $p = .02$, *ns*. As seen in Figure 3, the subjects relied on context when no animacy contrast was found (78% first-noun choice in the AA-N1 combination; 38% first-noun choice in the AA-N2 combination). However, when context conflicted with animacy,

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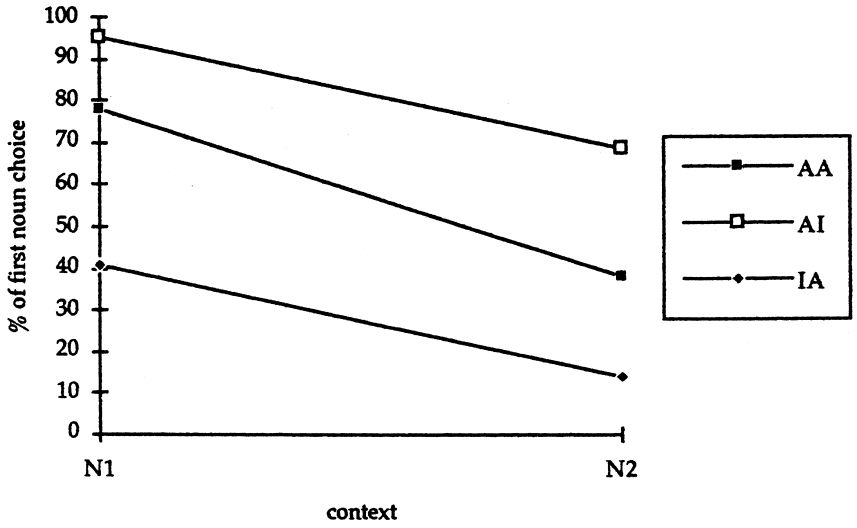


Figure 3. Percentage of first-noun choice as a function of Animacy × Context in the Chinese native speakers.

the Chinese controls depended more on animacy than on context (41% first-noun choice in the IA-N1 cell; 69% first-noun choice in the AI-N2 cell). For instance, *the rabbit* was selected as the agent most of the time in the target sentence *the door is swinging; the door bumps the rabbit*.

Figure 4 shows the Chinese controls' selection of the first noun in different context conditions for different sentence types. The sentence types were divided into three groups on the basis of animacy: that is, one group of semantically reversible cells (AA) and two groups of semantically nonreversible cells (AI, IA). The Chinese controls made use of contextual information to some extent; the differences in percentages of first-noun choice under different context conditions are noticeable in all cell types, but especially in AA items. Nevertheless, concerning the magnitude of each cue, animacy remained dominant in the Chinese controls' interpretation of their L1, even when context and word order were allied against animacy (i.e., 44% first-noun choice in the IVA-N1 cell, 68% in the AIV-N2 cell, and 73% in the VAI-N2 cell). For example, although both word order and context cues suggest that *the door* is the doer in the target sentence *the door is swinging; the door bumps the rabbit*, the subjects picked *the rabbit* as the actor most of the time.

Comparing the English controls with the Chinese controls, we found that the latter group depended on contextual information to a greater extent than did the former group. Although the main effect of context was not reliable in English sentence processing, it was significant and accounted for nearly one-third of the experimental variance in Chinese processing. The English controls' preference for the first noun in canonical NVN strings and the second noun in noncanonical NNV and VNN strings did not change according to context or when context

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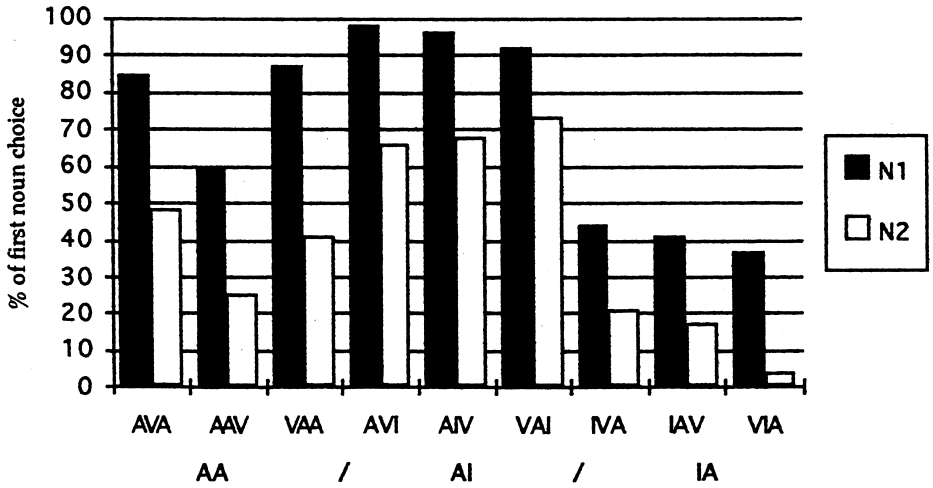


Figure 4. Chinese native speakers' choice of first noun under different context conditions.

allied with semantic information, particularly for canonical NVN string. Although the context cue played an important role in the Chinese controls' interpretation of their L1, the semantic information remained dominant. When the animacy cue was in conflict with the context cue, the former overrode the latter.

Context effects in Chinese EFL learners' processing of the L2

Now we turn to the performance of L2 learners of English and Chinese to see how they made use of contextual information in comprehending their respective L2. Table 3 shows the ANOVA results for each of the Chinese EFL groups on the L2 sentences. All three groups of learners made significant use of discourse context in processing their L2. However, the importance of the context cue differed across groups. The intermediate learners were most influenced by the context cue when processing their L2; the context cue accounted for 56% of the experimental variance, compared to 25% and 27% in the beginning and advanced groups, respectively. Animacy-based L1 strategies were preferred by beginning learners, accounting for 64% of the experimental variance; word order was the most important factor for the advanced subjects, accounting for 49% of the variance. There was an Animacy × Context interaction in the beginning and intermediate groups, but not in the advanced group (see Table 3). The context effect was especially pronounced on the semantically reversible AA stimuli. When there was animacy contrast, the animate noun was selected as the agent most of the time, even when context suggested the other interpretation. There was no significant Word Order × Context interaction in any L2 group, nor was there an interaction of Animacy × Word Order × Context.

To examine more closely how learners at different proficiency levels relied on the animacy, word order, and context cues in assigning the agent role in their

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Table 3. *ANOVA results for Chinese EFL groups in the English test*

Group and effect	*df*	*F* ratio	$p \leq$	Variance
Beginning EFL				
Animacy	2, 28	48.60	.0001	64%
Word order	2, 28	4.23	*ns*	—
Context	**1, 14**	**21.82**	**.001**	**25%**
Animacy × Word Order	4, 56	1.95	*ns*	—
Animacy × Context	**2, 28**	**5.93**	**.01**	**5%**
Word Order × Context	2, 28	3.31	*ns*	—
Animacy × Order × Context	4, 56	≤1	*ns*	—
Intermediate EFL				
Animacy	2, 28	47.71	.0001	30%
Word order	2, 28	7.59	.01	8%
Context	**1, 14**	**31.77**	**.0001**	**56%**
Animacy × Word Order	4, 56	1.03	*ns*	—
Animacy × Context	**2, 28**	**10.56**	**.001**	**3%**
Word Order × Context	2, 28	<1	*ns*	—
Animacy × Order × Context	4, 56	3.02	*ns*	—
Advanced EFL				
Animacy	2, 28	20.73	.0001	19%
Word order	2, 28	20.67	.0001	49%
Context	**1, 14**	**16.26**	**.01**	**27%**
Animacy × Word Order	4, 56	7.60	.0001	4%
Animacy × Context	2, 28	3.47	*ns*	—
Word Order × Context	2, 28	1.37	*ns*	—
Animacy × Order × Context	4, 56	1.25	*ns*	—

Note: Lines in boldface indicate significant effects.

L2, I plotted the noun choices of learners at each proficiency level for different sentence types under different context conditions (see Figures 5, 6, and 7). Sentence types were divided into three groups on the basis of animacy: one group of semantically reversible cells (AA) and two groups of semantically nonreversible cells (AI, IA). As shown in the figures, all of the EFL groups apparently paid attention to context when deciding on the agent–patient relation. The differences in noun choice under different context conditions are noticeable across cells, especially for semantically reversible items (i.e., AVA, AAV, VAA). However, there are still differences among the three learner groups in the extent of their reliance on the context vis-à-vis the two intrasentential cues. For the beginning learners, the animacy-based L1 strategies provided the most important information; the animacy cue dominated even when it encountered the combined influence of word order and context (e.g., 69% first-noun choice in the AIV-N2 cell and 80% in the VAI-N2 cell; see Figure 5). The intermediate learners were more influenced by context when interpreting L2 sentences; the differences in the percentage of first-noun choice under different contexts are striking for all of the sentence types (see Figure 6). The strong effect of context can be best

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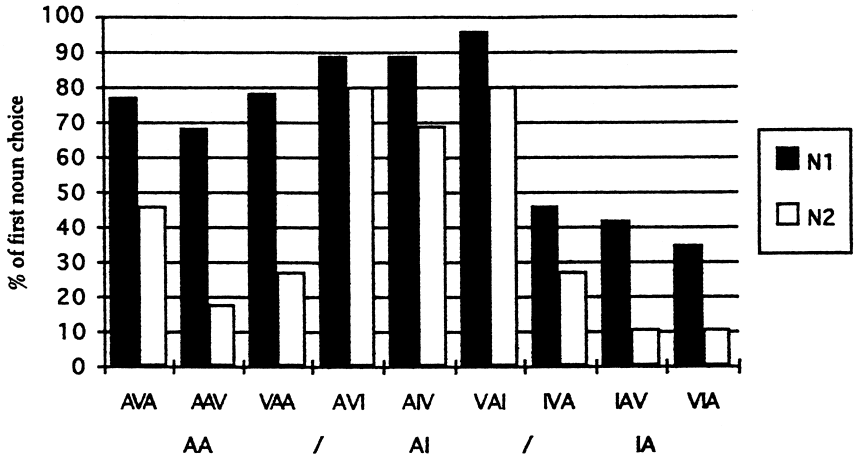


Figure 5. Beginning EFL learners' choice of first noun under different context conditions in the English test.

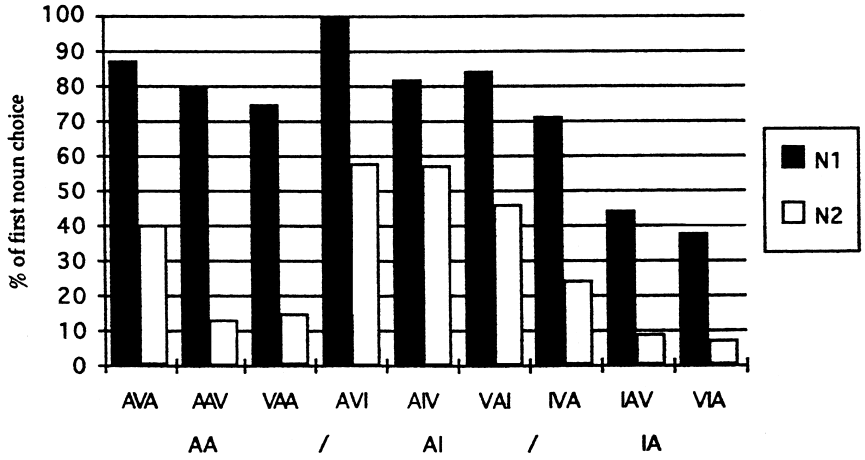


Figure 6. Intermediate EFL learners' choice of first noun under different context conditions in the English test.

illustrated in canonical NVN order. When processing sentences in isolation, this group of learners adopted an English SVO strategy in interpreting NVN order, not only when both nouns agreed in animacy (i.e., AVA, 96% first-noun choice), but also when animacy conflicted with word order (i.e., IVA, 64% first-noun choice).[6] However, when context was added, the first-noun choice dropped when context favored the second noun (40% first-noun choice for AVA-N2 and 24% for IVA-N2).

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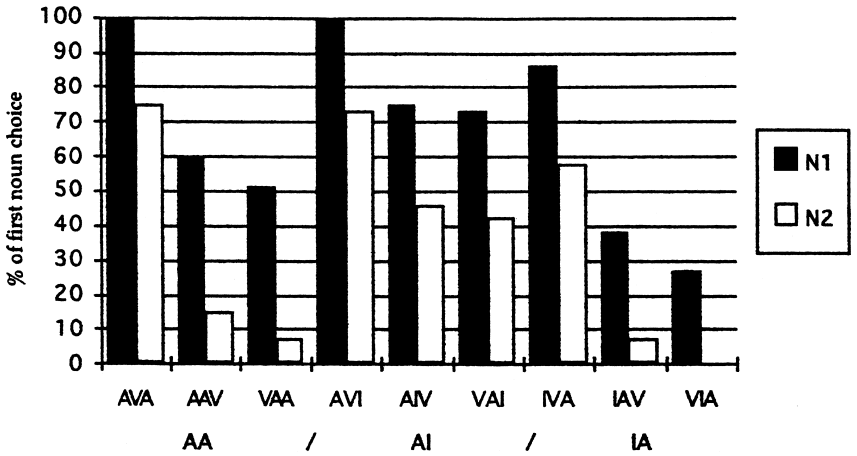


Figure 7. Advanced EFL subjects' choice of first noun under different context conditions in the English test.

It is interesting to note that, with less exposure to their L2, the beginning learners relied on the context cue to a lesser degree than did the intermediate learners when comprehending the L2. One possible reason involves cue cost. According to the Competition Model, an informative cue may be used less than we would otherwise expect because the processing costs involved in using that cue are high. With low proficiency in the L2, the beginning learners may have had difficulties in processing and storing the contextual sentences, and thus the context cue was of little use in their interpretation of the L2.

Context also had an effect on the choice behavior of the advanced subjects (see Figure 7). However, having the greatest exposure to the L2, the advanced subjects differed from the other two learner group in that the canonical SVO word order was preferred when it was in opposition to context and even to the combined influence of context and animacy. The former phenomenon is illustrated in the AVA-N2 cell (e.g., *The tiger is hungry; The rabbit bites the tiger*). Although context suggests that the second noun is the actor, the first noun was selected 75% of the time, compared to 46% and 40% in the beginning and intermediate groups, respectively. The latter can be seen in the IVA-N2 cell (e.g., *The monkey is naughty; The balloon pulls the monkey*); the first noun was chosen slightly above the chance level (58%), compared to 27% and 24% in the beginning and intermediate groups, respectively – even though both animacy and context suggest that the second noun is the actor.

A series of $2 \times 3 \times 3 \times 2$ (Group × Animacy × Word Order × Context) ANOVAs comparing each group of EFL learners with the Chinese controls on the use of the context cue showed no two-way, three-way, or four-way interaction involving group and context. This suggests that the EFL learners depended on contextual information in processing their L2 to a similar degree as did the Chinese controls when processing their L1.

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Table 4. *ANOVA results for English CFL groups in the Chinese test*

Group and effect	*df*	*F* ratio	$p \leq$	Variance
Beginning CFL				
Animacy	2, 28	22.13	.0001	8%
Word Order	2, 28	51.01	.0001	81%
Context	**1, 14**	**14.02**	**.01**	**5%**
Animacy × Word Order	4, 56	5.42	.001	3%
Animacy × Context	2, 28	3.23	*ns*	—
Word Order × Context	**2, 28**	**7.65**	**.01**	**2%**
Animacy × Order × Context	4, 56	1.69	*ns*	—
Intermediate CFL				
Animacy	2, 28	28.49	.0001	10%
Word Order	2, 28	31.32	.0001	71%
Context	**1, 14**	**12.83**	**.01**	**14%**
Animacy × Word Order	4, 56	7.42	.0001	4%
Animacy × Context	2, 28	1.28	*ns*	—
Word Order × Context	**2, 28**	**4.92**	**.01**	**1%**
Animacy × Order × Context	4, 56	<1	*ns*	—
Advanced CFL				
Animacy	2, 28	25.71	.0001	15%
Word Order	2, 28	25.88	.0001	64%
Context	**1, 14**	**11.31**	**.01**	**11%**
Animacy × Word Order	4, 56	9.45	.0001	5%
Animacy × Context	2, 28	4.77	*ns*	—
Word Order × Context	2, 28	3.78	*ns*	—
Animacy × Order × Context	4, 56	1.58	*ns*	—

Note: Lines in boldface indicate significant effects.

Context effects in English CFL learners' processing of the L2

Table 4 shows the results of the ANOVA of the three English CFL learner groups on the L2 sentences. As we can see from the table, L1 strategies based on word order were the determining factor in all three groups' processing of the L2, regardless of proficiency level. Across all groups, the main effect of word order not only was strongly reliable ($p \leq .0001$), but also accounted for the most of the experimental variance (beginning CFL, 81%; intermediate CFL, 71%; advanced CFL, 64%). The main effect of context was also reliable across the three groups ($p \leq .01$), but it accounted for a much smaller proportion of the variance (5%, 14%, and 11%). There was a Context × Word Order interaction in the beginning and intermediate groups but not in the advanced group (see Table 4). Overall, these subjects paid more attention to context when interpreting noncanonical NNV and VNN strings than canonical NVN order. No three-way interaction of Context × Animacy × Word Order was found in any CFL group.

For a clear illustration of how CFL learners at different proficiency levels incorporated the word order, animacy, and context cues in assigning the agent

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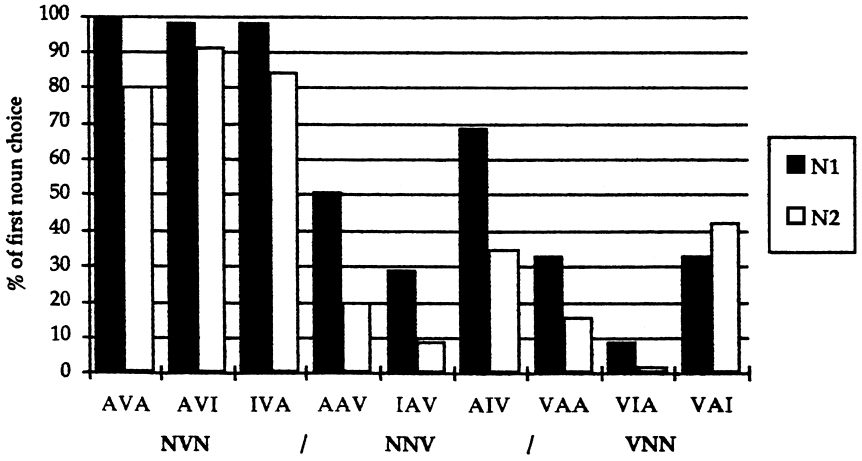


Figure 8. Beginning CFL learners' choice of first noun under different context conditions in the Chinese test.

role in their L2, see Figures 8, 9, and 10, which show the performance of each proficiency level on different sentence types under different context conditions. This time the sentence types were arranged into three groups on the basis of word order: canonical NVN order and noncanonical NNV and VNN orders. As shown in the figures, the differences in the percentages of first-noun choice were greater among noncanonical orders than in canonical order, which suggests that CFL learners paid more attention to context when interpreting noncanonical than canonical sentences. With exposure to a language that allows more word order variation, the CFL learners were becoming aware that semantic and contextual information were more important in processing their L2. However, SVO interpretation for NVN order dominated over the combined influence of animacy and context (i.e., IVA-N2); the percentage of first-noun choice for that cell was well above the chance level across all learner groups (beginning CFL, 84%; intermediate CFL, 82%; advanced CFL, 73%).

A series of $2 \times 3 \times 3 \times 2$ (Group × Animacy × Word Order × Context) ANOVAs comparing each group of CFL learners with the English controls on the use of the context cue revealed no significant Group × Context interactions. The CFL learners relied on sentential context to interpret their L2 to a greater extent than did the English controls in processing their L1; the effect of context was not statistically significant in the English controls' processing of their L1, whereas it was significant in all three groups of CFL learners' processing of their L1. While the English controls stuck to their word order strategies for all sentence types, CFL learners were more affected by the preceding context in determining the agent role for noncanonical sentences (compare Figure 2 to Figures 8, 9, and 10).

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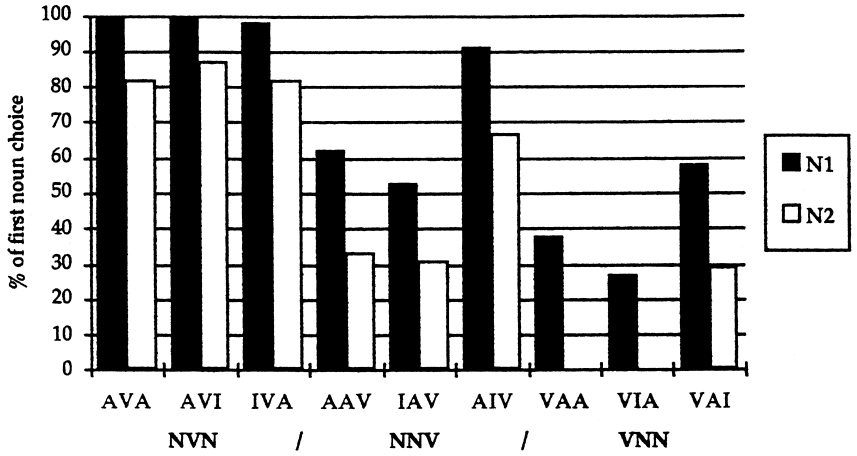


Figure 9. Intermediate CFL learners' choice of first noun under different context conditions in the Chinese test.

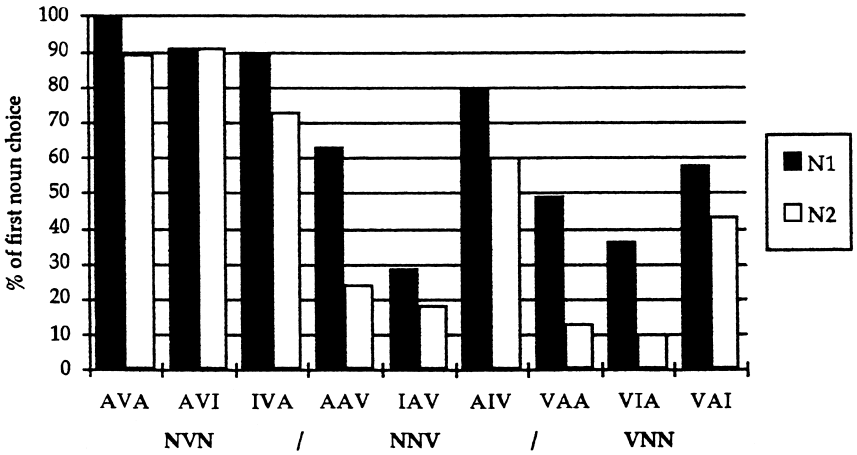


Figure 10. Advanced CFL subjects' choice of first noun under different context conditions in the Chinese test.

CONCLUSIONS

The present study is the first attempt to investigate the role of sentential context in the assignment of semantic roles in adult L1 and L2 speakers within the Competition Model framework. The main purposes were to see (a) how Chinese and English monolinguals incorporate an extrasentential cue (sentential context) in processing their respective L1 vis-à-vis intrasentential cues (animacy and

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word order), and (b) how learners of Chinese and English make use of sentential context in comprehending their L2.

Results show that the Chinese monolinguals depended on contextual information to a greater extent than did the English monolinguals. Whereas the main effect of context was not significant in the English controls' processing of their L1, it was significant in the Chinese controls' processing of their L1, accounting for nearly one-third of the experimental variance. The English controls' preference for word order strategies in interpreting their L1 did not change in light of prior context or when context was allied with semantic information, particularly for NVN strings. On the other hand, context appeared to play a role in the Chinese controls' processing of their L1, although the effect was limited. These results were in accordance with those of earlier studies investigating extrasentential cues in the assignment of the agent role (e.g., Gass, 1987; MacWhinney et al., 1984). Those studies found that extrasentential cues (stress, topic) were ineffective in English monolinguals' processing vis-à-vis the syntactic cue. However, for speakers whose L1 allows more possibilities for word order for pragmatic purposes (e.g., Italian, German), extrasentential cues did seem to have an impact, although the effect was still limited. Given that Chinese allows more word order variation, it is not surprising that native speakers of that language rely on context to some extent.

With regard to the L2 learners, Chinese EFL learners drew on context in processing their L2 to much the same degree as did the Chinese monolinguals when processing their L1, whereas English CFL learners made slightly greater use of discourse information than did English monolinguals, especially when interpreting noncanonical sentences. There were differences in the learners' reliance on context vis-à-vis the two intrasentential cues across levels. The intermediate groups of Chinese and English learners were most affected by context when interpreting their L2. Moreover, Chinese EFL learners depended on contextual information to a greater extent than did English CFL learners.

APPENDIX 1

Chinese test stimuli

NVN	NNV	VNN
AA Laohu zhua xiaomao.	AA Xiaoniao houzi yao.	AA Ti nuhai shizi.
N1 Laohu du zi er.	N1 Xiaoniao shengqi le.	N1 Nuhai hen shengqi.
N2 Xiaomao shengqi le.	N2 Houzi hen shengqi.	N2 Shizi hen xiong.
AI Nanhai qiao shitou.	AI Laoshu fengzheng zhui.	AI La xiaozhu qiqiao.
N1 Nanhai hen shengqi.	N1 Laoshu hen haoqi.	N1 Xiaozhu zai wan.
N2 Shitou gun xialai.	N2 Fengzheng wangshang fei.	N2 Qiqio zai shangsheng.
IA Damen zhuang tuzi.	IA Pingguo xiaoniu da.	IA Tui chuanghu xiaoguo.
N1 Damen zai yaohuang.	N1 Pingguo diao xialai.	N1 Chuanghu zai yao.
N2 Tuzi zai pao.	N2 Xiaoniu duzi e.	N2 Xiaogou hen haoqi.

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NVN	NNV	VNN
AA Tuzi yao laohu.	AA Xiaogou xiaomao ti.	AA Zhua xiaoniu xiaozhu.
N1 Tuzi hen shengqi.	N1 Xiaogou hen xiong.	N1 Xiaoniu zai wan.
N2 Laohu duzi e.	N2 Xiaomao shengqi le.	N2 Xiaozhu hen shengqi.
AI Xiaoniao la fengzheng.	AI Houzi pingguo zhuang.	AI Zhui nanhai qiqio.
N1 Xiaoniao hen haoqi.	N1 Houzi zai pao.	N1 Nanhai zai wan.
N2 Fengzheng wangshang fei.	N2 Pingguo gun xialai.	N2 Qiqio zai shangsheng.
IA Shitou da nuhai.	IA Chuanghu laoshu qiao.	IA Tui damen shizi.
N1 Shitou diao xialai.	N1 Chuanghu zai yaohuang.	N1 Damen zai yaohuang.
N2 Nuhai zai shengqi.	N2 Laoshu zai wan.	N2 Shizi hen haoqi.
NVN	NNV	VNN
AA Nuhai zhua nanhai.	AA Xiaogou shizi yao.	AA Ti xiaoniu xiaozhu.
N1 Nuhai zai shengqi.	N1 Xiaogou hen xiong.	N1 Xiaoniu shengqi le.
N2 Nanhai hen tiaopi.	N2 Shizi duzi e.	N2 Xiaozhu henxiong.
AI Xiaomao qiao pingguo.	AI Laoshu chuanghu tui.	AI Da laohu damen.
N1 Xiaomao hen haoqi.	N1 Laoshu zai wan.	N1 Laohu hen xiong.
N2 Pingguo luo xialai.	N2 Chuanghu zai yaohuang.	N2 Damen zai yaohuang.
IA Qiqiu la houzi.	IA Fengzheng xiaoniao zhui.	IA Zhuang shitou tuzi.
N1 Qiqiu wangshang fei.	N1 Fengzheng feiqilai.	N1 Shitou gun xialai.
N2 Houzi hen tiaopi.	N2 Xiaoniao hen xingfen.	N2 Tuzi zai pao.

Filler sentences

Animacy	Word order	Discourse context	Target sentence
AA	NVN	N1 Nuhai shier sui.	Nuhai zhua nanhai.
AA	NVN	N2 Nanhai hen ai.	Nuhai zhua nanhai.
AA	NNV	N1 Xiaogou shi heisede.	Xiaogou xiaomao ti.
AA	NNV	N2 Shizi shi Xiaomeide.	Xiaogou shizi yao.
AA	VNN	N1 Xiaoniu hen ganjin.	Zhua xiaoniu xiaozhu.
AA	VNN	N2 Xiaozhu hen zang.	Zhua xiaoniu xiaozhu.
AI	NVN	N1 Nanhai hen gao.	Nanhai qiao shitou.
AI	NVN	N2 Pingguo hen tian.	Xiaomao qiao pingguo.
AI	NNV	N1 Laoshu bu xihuang mao.	Laoshu chuanghu tui.
AI	NNV	N2 Pingguo shi lusede.	Houzi pingguo zhuang.
AI	VNN	N1 Nanhai shi wo didi.	Zhui nanhai qiqiu.
AI	VNN	N2 Damen hen xiao.	Da laohu damen.
IA	NVN	N1 Shitou shi yuande.	Shitou da nuhai.

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IA	NVN	N2 Tuzi xihuang hong luobuo.	Damen zhuang tuzi.
IA	NNV	N1 Fengzheng hen da.	Fengzheng xiaoniao zhui.
IA	NNV	N2 Laoshu hen keai.	Chuanghu laoshu qiao.
IA	VNN	N1 Damen shi heisede.	Tui damen shizi.
IA	VNN	N2 Tuzi shi baisede.	Zhuang shitou tuzi.

APPENDIX 2

English test stimuli

NVN	NNV	VNN
AA The tiger grabs the cat.	AA The bird the monkey bites.	AA Kicks the girl the lion.
N1 The tiger is hungry.	N1 The bird is angry.	N1 The girl is upset.
N2 The cat is angry.	N2 The monkey is mad.	N2 The lion is mad.
AI The boy knocks the stone.	AI The mouse the kite follows.	AI Pulls the pig the balloon.
N1 The boy is angry.	N1 The mouse is curious.	N1 The pig is playing.
N2 The stone is rolling.	N2 The kite is flying.	N2 The balloon is rising.
IA The door bumps the rabbit.	IA The apple the cow hits.	IA Pushes the window the dog.
N1 The door is swinging.	N1 The apple is falling.	N1 The window is swinging.
N2 The rabbit is running.	N2 The cow is hungry.	N2 The dog is curious.

NVN	NNV	VNN
AA The rabbit bites the tiger.	AA The dog the cat kicks.	AA Grabs the cow the pig.
N1 The rabbit is angry.	N1 The dog is mad.	N1 The cow is playing.
N2 The tiger is hungry.	N2 The cat is angry.	N2 The pig is mad.
AI The bird pulls the kite.	AI The monkey the apple bumps.	AI Follows the boy the balloon.
N1 The bird is curious.	N1 The monkey is running.	N1 The boy is playing.
N2 The kite is rising.	N2 The apple is rolling.	N2 The balloon is flying.
IA The stone hits the girl.	IA The window the mouse knocks.	IA Pushes the door the lion.
N1 The stone is falling.	N1 The window is swinging.	N1 The door is swinging.
N2 The girl is mad.	N2 The mouse is playing.	N2 The lion is playing.

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NVN	NNV	VNN
AA The girl grabs the boy.	AA The dog the lion bites.	AA Kicks the cow the pig.
N1 The girl is upset.	N1 The dog is mad.	N1 The cow is angry.
N2 The boy is naughty.	N2 The lion is hungry.	N2 The pig is excited.
AI The cat knocks the apple.	AI The mouse the window pushes.	AI Hits the tiger the door.
N1 The cat is curious.	N1 The mouse is playing.	N1 The tiger is wild.
N2 The apple is falling.	N2 The window is swinging.	N2 The door is swinging.
IA The balloon pulls the monkey.	IA The kite the bird follows.	IA Bumps the stone the rabbit.
N1 The balloon is rising.	N1 The kite is flying.	N1 The stone is rolling.
N2 The monkey is naughty.	N2 The bird is curious.	N2 The rabbit is jumping.

Filler sentences

Animacy	Word order	Discourse context	Target sentence
AA	NVN	N1 The girl is 12 years old.	The girl grabs the boy.
AA	NVN	N2 The boy is short.	The girl grabs the boy.
AA	NNV	N1 The dog is black.	The dog the cat kicks.
AA	NNV	N2 The lion is Mary's.	The dog the lion bites.
AA	VNN	N1 The cow is clean.	Grabs the cow the pig.
AA	VNN	N2 The pig is dirty.	Grabs the cow the pig.
AI	NVN	N1 The boy is tall.	The boy knocks the stone.
AI	NVN	N2 The apple is sweet.	The cat knocks the apple.
AI	NNV	N1 The mouse dislikes cats.	The mouse the window pushes.
AI	NNV	N2 The apple is green.	The monkey the apple bumps.
AI	VNN	N1 The boy is my brother.	Follows the boy the balloon.
AI	VNN	N2 The door is small.	Hits the tiger the door.
IA	NVN	N1 The stone is round.	The stone hits the girl.
IA	NVN	N2 The rabbit likes carrots.	The door bumps the rabbit.
IA	NNV	N1 The kite is big.	The kite the bird follows.
IA	NNV	N2 The mouse is cute.	The window the mouse knocks.
IA	VNN	N1 The door is black.	Pushes the door the lion.
IA	VNN	N2 The rabbit is white.	Bumps the stone the rabbit.

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NOTES

1. For a full discussion of the Competition Model, readers are referred to Bates and MacWhinney (1989) or MacWhinney and Bates (1987).
2. The present study is the second part of my doctoral thesis, submitted in August 1998 to the University of Hawaii at Manoa. The first part of my thesis, entitled *Transfer of sentence processing strategies: A comparison of L2 learners of Chinese and English*, concerns how L1 and L2 speakers of Chinese and English use animacy and word order cues to assign semantic roles in decontextualized sentences. In the second part of my thesis, context was added as a third experimental variable. Thus, although the research questions and test stimuli were different in the two studies, the subjects and test procedures were the same.
3. Throughout the article, all target sentences are underscored to distinguish them from contextual sentences.
4. The .01 level was selected because the study involved multiple ANOVA analyses.
5. Readers who are interested in how Chinese and English monolinguals and L2 learners of these languages make use of animacy and word order cues in comprehending decontextualized sentences are referred to Su (2001).
6. See Su (2001).

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