

## **The Effect of *-ga* Sequences on Processing Japanese Multiply Center-Embedded Sentences<sup>1</sup>**

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This study investigated the effect of more than two consecutive NPs bearing the nominative case-marker *-ga* on the processing difficulty associated with Japanese multiply center-embedded sentences. Experiment 1 found that NP-*ga* sequences are rated substantially less favorably for processability ratings than their matched counterparts; thus, theories that predict processing load must offer an account of this special source of processing difficulty. Experiment 2 used an alternation in Korean nominative particles *-i* and *-ka*, phonologically triggered, to narrow the sense in which it might be said that the cost of NP-*ga* sequences arises because of a problem in discriminating among consecutive NPs. In this case, processability ratings provided no evidence that confusable NP-Nom's are made more distinct by purely phonological variation in their case-markers.

### **1. Introduction**

For some three decades now, arguments about the character of sentence processing mechanisms have taken the obvious difficulty of multiply center-embedded sentences as a major point of focus. In head-initial languages such as English, doubly-embedded relative clauses (and especially, doubly-embedded object relatives) can be peculiarly problematic. In head-final languages such as Japanese, multiply-embedded sentential complements induce something like the same difficulty. Summarizing the special burdens offered by multiply center-embedded sentences, Eady and Fodor (1981) concluded that the processor has particular trouble with sequences of consecutive NPs, separated in the surface word string from the remainder of their clauses.

Sentence processing theories routinely predict that repetitive sequences of this kind lead to comprehension breakdown, though the grounds differ between frameworks; for example, Stabler's (1994) theory of case-assignment relations supposes the processing mechanism to be restricted in its ability to keep track of grammatical relations of the same kind; and Lewis's (1993, 1996) theory of X'-relations supposes that a sharply limited working memory suffers similarity-based interference when it is overloaded. For Babyonyshev and Gibson (1995) (henceforth, B&G), the claim is that two factors determine level of difficulty for multiply center-embedded sentences: First, the number of structurally-cased NPs (Nom, Acc, and Gen) not yet assigned theta-roles; and second, the number of self-embeddings (SEs). In B&G's theory, sentences become unprocessable when the number of Processing Load Units (PLUs) they accumulate exceeds a critical limit which is set universally at 4 PLUs.

Native-speaker intuition suggests, for Japanese, that center-embeddings manifest a source of processing difficulty not yet recognized in B&G's metric,

and handled only indirectly by other theories of sentence processing; and that is, beyond the known problems of NP-repetition, a cost of NP-*ga* repetition arising when more than two consecutive NPs bear the nominative case-marker *-ga*. In this paper, we present our investigation of NP-*ga* repetition in multiply center-embedded sentences, and confirm that the *ga*-effect has a substantial impact on processing difficulty. We also report a follow-up study investigating whether NPs bearing the same case are less discriminable than they otherwise would be, for non-syntactic reasons. Here, we make use of a phonologically conditioned alternation in the nominative case-marker in Korean, and find that identity in a particle's phonological form is not what is at issue.

## 2. Experiment 1

Two off-line judgement tasks were used to investigate the effect of more than two consecutive NPs marked by the same nominative case-marker *-ga* on the processing difficulty associated with Japanese multiply center-embedded sentences. The critical contrasts of the experiment involved sentences that were constructed as minimal pairs, one of the pair containing a sequence of three or more consecutive NP-*ga* phrases (henceforth, *3ga*) and its counterpart avoiding the *3ga* sequence in one of a variety of ways.

**2.1. Subjects.** Thirty-two native speakers of Japanese (average age, 31 years, average length of stay in the U.S., 3;6 years, all having a B.A. degree from a college in Japan) participated voluntarily in Experiment 1 by completing two tasks in a questionnaire. Usually this took no more than 15 minutes.

**2.2. Materials and Procedure.** The questionnaire presented multiply center-embedded sentences in two forms, Experimental (EXP) and Control (CON). These critical sentences were all sufficiently complex (i.e., 5 PLUs in B&G's metric) to predict "unprocessability", and the EXP sentences contained more than two consecutive NPs marked with *-ga*. Task 1 presented sentences singly, and required absolute processability judgements on a 6-point scale whose end points (very easy vs. impossible to understand) were represented by symbols frequently used in Japanese culture. The crucial middle scale points allowed subjects to indicate the difference between a sentence that was understandable (though barely) and one that led to processing overload. Task 2 presented minimal pairs (an EXP sentence with its CON counterpart), and asked for judgments of relative processability (EXP better, EXP/CON same, CON better).

For each EXP sentence, a CON counterpart was constructed so as to hold meaning and punctuation constant, while avoiding the NP-*ga* sequence through the following sentence-conversion devices:

- (a) *-ga/-no* conversion and *-ga/-o* conversion: Part of the *-ga* sequence was replaced by an NP bearing the genitive case-marker *-no*, or the accusative case-marker *-o*. The first of these conversion devices is permitted by the fact that, in Japanese, *-no* (Gen) can mark not only a possessor of an NP

but also the subject of a relative clause or the head of a noun-complement clause; and the second, by the fact that stative predicates (adjectives, noun adjectives, and stative verbs) permit their object to be marked either with *-ga* or with *-o* (Acc) (Kuno 1973). Of these two, only *-ga/-no* was used in Task 1; however, both conversion devices were included in Task 2.

- (b) *-ga/-wa* conversion: The first NP-*ga* of the *-ga* sequence was topicalized and thus marked by *-wa*. Since topicalization involves few constraints, *-ga/-wa* conversion was tested in three different structures. The first had 3 nominative NPs marked by *-ga*, 1 accusative NP marked by *-o*, and 1 self-embedding (SE), and the second, 3 NPs all marked by *-ga* and 2 SEs. The third type, like the first, had 4 NPs and 1 SE, but marked all its NPs with *-ga* — the verbs used were those permitting *ga*-marked objects — so that this last variety of *-ga/-wa* conversion contrasted processability for 4*ga* versus 3*ga* sequences.
- (c) ADV insertion: The NP-*ga* sequence was split up by the insertion of an adverb after the second NP-*ga*. In the original 3*ga* sentence, the adverb appeared in the same clause, but later, in association with the verb.

Note that none of these devices affect PLU count according to B&G's theory (M. Babyonyshev, personal communication), although *-ga/-no* conversion and topicalization are assumed to involve movement, and so would be predicted to increase processing difficulty in other models of parsing, cf. the Minimal Chain Principle, de Vincenzi (1991).

To construct test materials for Task 1, EXP and CON sentences were first created in minimal pairs as outlined above—two such pairs for *-ga/-no*, for each of the three varieties of *-ga/-wa*, and for ADV insertion—for a total of 20 test sentences. The sentences of (1) to (3) below illustrate pairs for *-ga/-no*, *-ga/-wa* (Type 1), and ADV insertion, respectively<sup>2</sup>:

- (1) a. [Keiichi-ga [otooto-ga [[ryoosin-ga dekaketa] toki kaettekita] no-ni tomadotta]  
PN-Nom brother-Nom parents-Nom went-out time came-home fact-at embarrassed  
b. [Keiichi-ga [otooto-ga [[ryoosin-no dekaketa] toki kaettekita] no-ni tomadotta]  
PN-Nom brother-Nom parents-Gen went-out time came-home fact-at embarrassed  
"Keiichi was embarrassed at the fact that his brother came home when their parents went out."
- (2) a. [Sato-san-ga [Takahashi-san-ga [sono hito-ga Yamane-san-o kokusosita] to omotta ] to itta]  
PN-Mr.-Nom PN-Mr.-Nom the person-Nom PN-Mr.-Acc sued that thought that said  
b. [Sato-san-wa [Takahashi-san-ga [sono hito-ga Yamane-san-o kokusosita] to omotta ] to itta]  
PN-Mr.-Top PN-Mr.-Nom the person-Nom PN-Mr.-Acc sued that thought that said  
"Mr. Sato said that Mr. Takahashi thought that the person sued Mr. Yamane."
- (3) a. [Keiko-ga [Tadashi-ga [sensei-ga Kenji-o kiraida] to kesa itta] to omotteiru]  
PN-Nom PN-Nom teacher-Nom PN-Acc hates that **this morning** said that thinks  
b. [Keiko-ga [Tadashi-ga kesa [sensei-ga Kenji-o kiraida] to itta] to omotteiru]  
PN-Nom PN-Nom **this morning** teacher-Nom PN-Acc hates that said that thinks  
"Keiko thinks that Tadashi said this morning that the teacher hates Kenji."

The construction of two minimal pairs for each conversion device permits critical sentences to be distributed with an appropriate counterbalancing design over two versions of the questionnaire; EXP and CON exemplars of each device

are included in either version, without repeating lexical content. Additionally, 10 filler sentences varying in structure and complexity were interspersed among the test sentences.

Task 2, asking the same subjects who had undertaken Task 1 to now make judgments of relative processability, employed just 6 critical minimal pairs (one for each of Task 1's conversion devices, plus *-ga/-o* conversion). These pairs were presented in identical form to all 32 subjects, formatted so that each EXP sentence was immediately above the CON with which it was to be compared.

The questionnaire was given to subjects as a booklet printed in Japanese script. Its first section sought demographic information, and gave instructions about how to complete the tasks together with practice items. Then, absolute processability judgments were made before relative judgments, so that subjects would not know what constituted the critical comparisons of the questionnaire while completing Task 1. Subjects were asked to complete the questionnaire at their own pace, with no back-tracking, and were urged to read (and understand) sentences at the speed which felt most natural for them.

**2.3 Results and Discussion.** The analysis of Task 1's absolute processability judgment data assumed that subjects treated the 6-point rating scale as at least quasi-interval. Thus, responses were converted to numerical values ("very easy to understand" = 1, "impossible to understand" = 6), and their distribution was analyzed parametrically. Table 1 presents mean processability ratings for each conversion type, together with analysis outcomes for EXP/CON comparisons.

**Table 1. Mean rated processability for EXP and CON sentences as a function of conversion device**

Conversion Type	Sentence Structures		Rating	F <sup>1</sup>
<i>-ga/-no</i>	[-ga [NP[IP -ga [NP[IP -ga V]] V]] V]		3.88	8.75 **
	[-ga [NP[IP -ga [NP[IP -no V]] V]] V]		3.09	
<i>-ga/-wa # 1</i>	[-ga [IP -ga [IP -ga -o V] V] V]		4.31	20.07 ***
	[-wa [IP -ga [IP -ga -o V] V] V]		3.16	
<i>-ga/-wa # 2</i>	[-ga [NP[IP -ga [NP[IP -ga V]] V]] V]		3.59	4.78 *
	[-wa [NP[IP -ga [NP[IP -ga V]] V]] V]		2.84	
<i>-ga/-wa # 3</i>	[-ga [IP -ga -ga [IP -ga V] V] V]		4.72	8.66 **
	[-wa [IP -ga -ga [IP -ga V] V] V]		4.03	
ADV insertion	[-ga [IP -ga [IP -ga -o V] Adv V] V]		4.53	16.19 ***
	[-ga [IP -ga Adv [IP -ga -o V] V] V]		3.63	

<sup>1</sup> Degrees of freedom (1,30)

\* p < .05 \*\* p < .01 \*\*\* p < .001

For each EXP/CON comparison, separately, analyses showed that the *3ga* versions of sentences were rated as less processable than their counterparts, and an overall analysis (with factors Conversion x Comparison) showed further that the magnitude of the *3ga* cost did not differ among the cases tested,  $F < 1$  for the interaction term. The presence of a *3ga* sequence resulted, overall, in a shift in processability of 0.86 units on the 6-point rating scale, which is roughly the cost associated with one additional PLU (see Uehara, to appear).

Task 2's relative processability judgments data were analyzed with a non-parametric technique (Binomial Test), with separate tests for each of 6 minimal pairs. That analysis compared frequencies in the response categories declaring a preference between EXP and CON, and set aside "EXP/CON same" responses (the latter amounting to some 15% of the data). In every instance, the sentence version with fewer consecutive NP-*ga*'s was preferred,  $p < .01$ . Thus, for *-ga/-no* conversion, 87% of preference responses took CON to be easier than EXP; for the *-ga/-wa* conversions, 100%, 93%, and 100% of preferences favored CON, for the first, second, and third types, respectively; and for ADV insertion, 93% of preferences took the CON version to be easier. Finally, for the test of *-ga/-o* conversion, included in Task 2 for the first time, 91% of responses declaring a preference favored CON over its EXP counterpart. In sum, outcomes for Task 2 entirely replicated those for Task 1.

The findings of Experiment 1 establish that sequences of more than two consecutive NP-*ga*'s add very noticeably to the difficulty of center-embedding. But why should NP-*ga* repetition increase processing cost? Given the problems the parser faces as it projects structural analyses in such sentences, what seems most likely is that repetition impairs discriminability among NPs which must be retained in memory awaiting their structural assignments. It is of interest here that Rosenbaum and Kim (1976) (henceforth, R&K) observed a clear contrast in ease of comprehension, for multiply center-embedded sentences in Korean:

- (4) # [ku ay-tul-i [wuli hyeng-i [sensayng-i olh-ko-lul] palanta-nun kes-ul] alkoissta]  
 that child-Pl-Nom we brother-Nom teacher-Nom right-that-Acc wish-AdNom that-Acc knows  
 "The children know that my brother wishes that the teacher is right." (R&K 1976: 54)
- (5) [ku ay-tul-i [wuli apenim-kkeyse [nal ssi-ka kay-ko-lul] palako-keysita-nun-kes-ul] alkoissta]  
 that child-Pl-Nom we father-Nom(Hon) weather-Nom clear-that-Acc wish(Hon)-AdNom that-Acc knows  
 "The children know that our father wishes that the weather clears up." (R&K 1976: 47)

R&K characterize the notably more difficulty (4) as lacking the variety of "structure aiding cues" which together conspire to support comprehension in the identically structured (5). Three consecutive sentence-initial NPs bear the same nominative case-marker *-i* in the former, but three different nominative particles *-i*, *-kkeyse*, and *-ka* in the latter. The easier sentence benefits also from subject-predicate combinations which are closely guided; that is, honorific agreement in (5) selects *father-wish*, and lexical/conceptual content selects *children-know* and *weather-clear up* (cf. the combinatorial freedom in (4) among subjects nouns *children*, *brother*, and *teacher*, and predicates, *know*, *wish*, and *be right*).

The cues to structure exploited in (5) seem to fall into two different types: The first sets up a basis for distinguishing among NPs, and the second, a means for supporting relations between constituents. Since the point that R&K wished to make was a general one — concerning the role of non-syntactic information in comprehension — their sentences tested cues acting jointly. But for asking whether impaired discriminability of a particular kind underlies the cost of NP-ga repetition, only the first of R&K's types is relevant, and so the contrasts built into Experiment 2 test only for the effect on processability of variation in the nominative case-marker's form.

### 3. Experiment 2

Variation between forms *-i* and *-ka* of the nominative particle in Korean depends on whether a subject noun ends with a consonant or vowel; that is, the alternation is phonologically conditioned. The alternation allows us to find out whether multiply center-embedded sentences with three consecutive NP-Nom's incur an increased processing cost because of identity in the phonological form of the case-marker. If the *3ga* cost arises because NPs awaiting their structural assignments are less phonologically discriminable, phonological conversion of *3i* (or *3ka*) sentences should lead to improved processability ratings, just as the conversion devices used in Experiment 1 have been shown to do.

The experiment is carried out in Korean rather than Japanese, because this phonological alternation is just not available in Japanese. And, since factors other than a lexical item's phonology control occurrences of the form *-kkeyse*, the honorific marker for subjects — note also that honorific agreement rules bring into play structure-cueing of R&K's second type — only *-i* and *-ka*, but not *-kkeyse*, are included among the case-marker variants.

**3.1. Subjects.** Forty native speakers of Korean (average age 27 years, average length of stay in the U.S. 9 months) participated in the experiment, and were paid a small fee. All had obtained a B.A. degree from a college in Korea, and were attending a summer session at a college in New York. The questionnaire usually took no more than 20 minutes.

**3.2. Materials and Procedure.** Subjects completed a questionnaire printed in Korean script. The questionnaire presented sentences singly, for processability judgements on a 6-point scale as in Experiment 1.

Materials preparation began with the construction of structural skeletons for self-embedded sentences; all had 4 structurally-cased NPs (3 Nominative, 1 Accusative) and 1 SE, for a complexity count of 5 PLUs according to B&G's metric. Skeletons for *3i* sentences specified consonant-final lexical items for all subject NPs, and a vowel-final lexical item for an object NP to be marked with *-lul* (Acc), while those for *3ka* sentences specified vowel-final subject NPs and a consonant-final object NP to be marked with *-ul* (Acc). Experimental (EXP) and Control (CON) versions of otherwise equivalent sentences — EXP having

three consecutive NP-*i*'s or NP-*ka*'s, and CON one fewer — were created by changing only the specification (as vowel-final or consonant-final) of the lexical item for NP<sub>3</sub>, the most deeply embedded subject position. Care was taken in selecting lexical items so that this phonological conversion would alter overall plausibility of sentence meanings as little as possible; moreover, kinship terms were replaced by kinship terms, proper names by proper names, and so on.

This basic design was expanded by the inclusion of a complexity factor. That is, 3 PLU sentences were created by dropping out the middle clauses (i.e., NP<sub>2</sub> ...V<sub>2</sub>) of the 5 PLU originals; their complexity was lowered through loss of 1 structurally cased NP and 1 SE. Thus the final design reflected the factorial combination of Phonological Conversion and Complexity.

Four different sentences were created for each of the *3i* and *3ka* skeletons, differing only in lexical content. These 8 basic sentences were then adapted to achieve phonological conversion, as outlined above; and finally, each of the resulting 16 sentences was further adapted to reduce complexity. The outcome was a materials set of 32 test sentences, 8 sets of quadruples (cf. Experiment 1's pairs); (6a-d), below, illustrate one such set:

- (6) a. [Sachon-i [Kyengchal-i [Kiyeong-i wuncensa-lul ttayliessta] ko cwucanghanta] ko cenhay cwuessta]  
 cousin-Nom police-Nom PN-Nom driver-Acc hit that insisted that report gave  
 "My cousin told (me) that the police insisted that Kiyeong hit the driver."
- b. [Sachon-i [Kyengchal-i [Yengswu-ka wuncensa-lul ttayliessta] ko cwucanghanta] ko cenhay cwuessta]  
 cousin-Nom police-Nom PN-Nom driver-Acc hit that insisted that report gave  
 "My cousin told (me) that the police insisted that Yengswu hit the driver."
- c. [Sachon-i [Kiyeong-i wuncensa-lul ttayliessta] ko cenhay cwuessta]  
 cousin-Nom PN-Nom driver-Acc hit that report gave  
 "My cousin told (me) that Kiyeong hit the driver."
- d. [Sachon-i [Yengswu-ka wuncensa-lul ttayliessta] ko cenhay cwuessta]  
 cousin-Nom PN-Nom driver-Acc hit that report gave  
 "My cousin told (me) that Yengswu hit the driver."

Test sentences were distributed to form a questionnaire in four counter-balanced versions. Each version was supplemented by 40 filler sentences.

**3.3. Results and Discussion.** As in Experiment 1, the processability judgment data were treated parametrically.

**Table 2. Mean rated processability as a function of phonological conversion and complexity**

Complexity	Phonological Conversion	
	EXP	CON
5 PLU	3.28	3.30
3 PLU	2.04	1.79

Table 2 presents mean processability ratings at two levels of complexity, for EXP sentences having consecutive sequences of NP-*i* or NP-*ka* phrases, and for CON counterparts with one less phrase in the sequence bearing the same phonological form. The data shown in the table collapse over NP-*i* and NP-*ka*, since the analysis showed no effect of marker type,  $F(1,36) = 1.22$ ,  $p > .25$ , nor an interaction of marker with other factors,  $p > .25$  for all terms.

Overall, processability ratings for EXP sentences (mean rating 2.66 on the 6-point scale) did not differ from those for CON sentences (mean rating 2.54),  $F(1,36) = 2.07$ ,  $p > .10$  for the phonological conversion effect; and conversion did not interact with complexity,  $F(1,36) = 2.31$ ,  $p > .10$ . However, the data themselves assure us that the failure to detect any benefit of a phonologically conditioned variation in nominative case-marking is not due to any insensitivity in the way subjects used the rating scale; clearly, more complex sentences were much less favorably rated for processability (mean rating 3.29) than simpler sentences (mean rating 1.91),  $F(1,36) = 97.71$ ,  $p < .001$ . The 2 PLU difference in complexity was strongly reflected in judgments of processability, and gave rise to a shift of 1.38 rating scale units.

Experiment 2's finding is that the processing cost associated with more than two consecutive NP's marked for nominative case (which we identified for Japanese as the 3*ga* cost) is not lower when phonological environment triggers variation in case-marker form; that is, NP-*i* NP-*i* NP-*ka* sequences, say, are not detectably less burdensome than are NP-*i* NP-*i* NP-*i* sequences. Phonological conversion is thus quite unlike the conversion devices explored earlier. With the assumption that the finding can sensibly be carried across languages — that if Japanese permitted phonological conversion, things would turn out the same way — Experiment 2 (in Korean) leads us to the conclusion that the problem with 3*ga* (in Japanese) is not one which turns on phonological discriminability.

#### 4. General Discussion

The experiments reported in this paper, taken together, suggest that more than two consecutive NPs, marked for nominative case, make multiply center-embedded sentences much harder to process; and further, that it is repetition of *nominative case*, rather than repetition of particular *phonological forms*, that is problematic.

We might wonder, then, whether processing difficulty increases whenever the parser comes upon NP-sequences marked with the same case, whatever that case might be. Unfortunately, it is tricky to test for an effect of repetition with case-markers other than *-ga*, due to structural limitations: Sentences with NP-*o* sequences, say, are awkward for reasons that have little to do with repetition *per se*. However, in one special instance, Cowper (1976) has made an observation suggesting that the NP-Nom problem is unlikely to generalize: Multiply center-embedded sentences in which the topic marker *-wa* is repeated are much easier to process than those in which nominative *-ga* is repeated.



- (7) a. # [Watasi-ga [Yamada-san-ga [nezumi-ga chiizu-o tabeta] to itta] to omoimasu]  
 I-Nom Yamada-Mr.-Nom mouse-Nom cheese-Acc ate that said that think  
 "I think Mr. Yamada said the mouse ate the cheese." (Cowper 1976: 87)
- (8) [Watasi-wa [Yamada-san-wa [sensei-wa tegami-o kaita] to itta] to omoimasu]  
 I-Top Yamada-Mr.-Top teacher-Top letter-Acc wrote that said that think  
 "I think Mr. Yamada said the teacher wrote the letter." (Cowper 1976: 87)

At minimum, the contrast of (7) and (8) indicates that if a *3wa* cost exists, it is notably less than the *3ga* cost. In the parsing model that Cowper proposes, NP-*wa* and NP-*ga* phrases are handled by different mechanisms, the idea being that topic NPs (already established in the discourse) make modest demands on memory resources, while non-topic NPs must be retained in a limited-capacity store. Certainly the flavor of this claim accords with a function ascribed to the use of *-ga* by the traditional literature, the signaling of new information (Kuno 1973, 1978); in these terms, several consecutive NP-*ga* phrases may overwhelm the processor with too much that is presented as new<sup>3</sup>. Nonetheless, Cowper's appeal to an inherent difference in processing mechanism for NP-*ga* and NP-*wa* phrases seems more stipulative than explanatory, and particularly so since the contrast to which she draws attention is strongly supported by native intuition, in the absence of any discourse context.

The situation calls for careful investigation of the processability of NP-*ga* versus NP-*wa* sequences, perhaps with and without discourse support, so that a crucial question can be answered: Is there something particular about nominative marker *-ga* that it induces substantial processing cost in repetitive use — or rather, something particular about topic marker *-wa* that it does not?

## 5. Conclusions

The cost of sequences with more than consecutive two NP-*ga*'s must now be included among the predictors of processing load for sentences with multiple embedding, and theories must offer an account of this difficulty. For progress in theory-construction, we require that the precise problem with such sequences be appropriately characterized; and as a first step in this direction, we suggest that accounts should not be cast in terms of phonological discriminability. The difficulty apparently lies in repeated use of the same case, rather than repeated use of the same form; strictly, we should be speaking of a problem arising from repetition of the syntactic element. This last conclusion denies one component of the claim made by R&K for Korean; note, though, that these authors looked at the joint rather than the independent action of several kinds of non-syntactic information. To whatever extent—and in whatever way—sentence processing mechanisms can exploit additional information sources to make comprehensible an otherwise unprocessable multiply center-embedded structure, the suggestion must be that what is most likely to be beneficial is information that restricts the candidate set of constituent relations.

## Notes

- <sup>1</sup> We gratefully acknowledge the contributions made by Janet Dean Fodor and John Whitman, who provided comments and advice in the course of this project, and also the contribution of Soon Ae-Chung, who assisted in the construction of Korean materials.
- <sup>2</sup> For reasons of space, materials lists could not be included in this paper. A full list of the critical materials for the experiments reported is obtainable on request from: Keiko Uehara, PhD Program in Linguistics, CUNY Graduate School and University Center, 33 West 42nd Street, New York NY 10036-8099, USA.
- <sup>3</sup> Another reported use of *-ga*, "exhaustive listing", is seen as picking a specific entity out of the current universe of discourse (Kuno 1973, 1978). An explanation of *ga*-cost within this tradition would perhaps say that repetitive use of *-ga* is less than felicitous, since appropriate contexts for each of three new entities are unlikely.

## References

- Babyonyshev, Maria, and Edward Gibson. 1995. Processing overload in Japanese. *Papers on Language Processing and Acquisition, MITWPL* 26: 1-35.
- Cowper, Elizabeth. 1976. *Constraints on Sentence Complexity: A Model for Syntactic Processing*. Doctoral dissertation, Brown University.
- De Vincenzi, Marica. 1991. *Syntactic Parsing Strategies in Italian*. Dordrecht: Kluwer.
- Eady, Stephen J. and Janet Fodor. 1981. Is center-embedding a source of processing difficulty? Paper presented at the Annual Meeting of the Linguistic Society of America, New York.
- Kuno, Susumu. 1973. *The Structure of the Japanese Language*. Cambridge: MIT Press.
- Kuno, Susumu. 1978. *Danwa-no Bunpoo*. Tokyo: Taishuukan.
- Lewis, Lawrence. 1993. *An Architecturally-Based Theory of Human Sentence Comprehension*. Doctoral dissertation, Carnegie Mellon University.
- Lewis, Lawrence. 1996. Interference in short-term memory: The magical number two (or three) in sentence processing. *Journal of Psycholinguistic Research* 25: 93-115.
- Rosenbaum, Harvey, and Kong-On Kim. 1976. Factors affecting comprehension in Korean and English self-embedded structures. *Working Papers on Language Universals* 20: 43-57.
- Stabler, Edward. 1994. The finite connectivity of linguistic structure. In Charles Clifton Jr., Lyn Frazier, and Keith Rayner, eds., *Perspectives on Sentence Processing*. Hillsdale, NJ: Lawrence Erlbaum Associates.
- Uehara, Keiko. Judgements of processing load in Japanese: The effect of NP-*ga* sequences. *Journal of Psycholinguistic Research* (to appear).