Evidence for the linearization-based theory of semantic composition

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Proceedings of the 14th International Conference on
Head-Driven Phrase Structure Grammar

Stanford Department of Linguistics and CSLI's LinGO Lab

Stefan Müller (Editor)

2007

Stanford, CA: CSLI Publications

pages 323–343

Yatabe, Shûichi. 2007. Evidence for the linearization-based theory of semantic composition. In Stefan Müller (ed.), *Proceedings of the 14th International Conference on Head-Driven Phrase Structure Grammar, Stanford Department of Linguistics and CSLI's LinGO Lab*, 323–343. Stanford, CA: CSLI Publications. DOI: 10.21248/hpsg.2007.19.


Abstract

The result of questionnaire studies are presented which shows (i) that conjuncts are scope islands in Japanese and (ii) that left-node raising can nullify such scope islands. This finding confirms the theory advanced in Yatabe (2001), in which semantic composition is almost entirely carried out within order domains, and arguably contradicts the theory proposed in Beavers and Sag (2004), which introduces a mechanism called Optional Quantifier Merger to deal with the fact that right-node raising and left-node raising can have semantic effects.

1 Introduction

It is undeniable that right-node raising (RNR) and left-node raising (LNR) (see Yatabe (2001)) can affect semantic interpretation. At the same time, there seems to be a growing consensus that RNR and LNR should be analyzed in terms of some linearization-related mechanism rather than the SLASH mechanism and its equivalents (see Yatabe (2001) and Beavers and Sag (2004) for some recent discussion within the context of HPSG). Thus an adequate theory of RNR and LNR must be able to explain how it is that linearization-related mechanisms can affect semantic interpretation; a theory like that presented in Kathol and Pollard (1995), which is based on the assumption that semantic composition is not affected by what happens in order domains, turns out to be inadequate.

There have been two proposals regarding how to allow semantic interpretation to be affected by linearization-related mechanisms. One is the theory advanced in Yatabe (2001), in which semantic composition is almost entirely carried out within order domains. The other is the theory proposed in Beavers and Sag (2004), which retains the more conventional view of semantic composition and in which the relevant observations are explained by simply adding a mechanism called *Optional Quantifier Merger* to the grammar.

The aim of this paper is to present evidence that favors the former theory over the latter. First, in Section 2, problems with SLASH-based theories of RNR and LNR will be enumerated. In Section 3, the two linearization-based theories of RNR and LNR that are to be compared will be described in some detail. Then, in Section 4, evidence will be presented which appears to favor the theory proposed in Yatabe (2001). Finally, it will be examined in Section 5 whether the analysis that is proposed for Japanese in this paper is applicable to English as well.

[†]I thank the two anonymous reviewers and the audience at the conference, especially Rui Chaves and Ivan Sag, for helpful comments, and Brendan Wilson for his input regarding the interaction of quantification and coordination in English.

2 Problems for SLASH-based theories of RNR and LNR

RNR and LNR are clearly capable of affecting the meaning of a sentence, as shown by examples such as (1), taken from Abbott (1976).

(1) a. I borrowed, and my sister stole, a total of $3000 from the bank.

b. I borrowed a total of $3000 from the bank and my sister stole a total of $3000 from the bank.

Given the standard theory of semantic composition, this seems to mean that RNR and LNR alter the syntactic structure of a sentence; more specifically, it seems to mean that RNR and LNR should be given a treatment in terms of the SLASH mechanism or its equivalents in other frameworks, as in Gazdar (1981).

However, there are numerous differences between RNR and LNR on the one hand and instances of leftward extraction such as topicalization and relativization on the other that are difficult to account for if RNR and LNR constructions are to be viewed as instances of SLASH dependency.

First, RNR can strand prepositions even in languages such as Irish, Polish, and Spanish, in which leftward extraction is not allowed to strand prepositions (McCloskey, 1986).

Second, part of a word can be right-node-raised, as in (2), an example taken from Wilder (1997) (see also Booij (1984)).

(2) the in- and the output of this machine

Part of a word can also be left-node-raised, as shown by the Japanese example (3b), which is arguably a result of applying LNR to (3a) (see Yatabe (2001)). The verb *omoidas-* 'to recall' that is used in these examples is a compound verb made up of two verb stems, *omoi-* 'to think' and *das-* 'to get (something) out'.

(3) a. [Omoidasu ka] [omoidasanai ka] ga mondai da.
[recall-PRES Q] [recall-NEG-PRES Q] NOM problem COP-PRES
'Whether (you) can recall (it) or (you) cannot recall (it) is the problem.'

b. Omoidasu ka dasanai ka ga mondai da. <12, 3, 1, 0>

The figures immediately following (3b), (4b), and (4c) represent the result of a questionnaire study conducted in 2006. The respondents in this study consisted of students at the University of Tokyo who were not linguists, and they were compensated for their time. Where the relative acceptability of two or more examples was of interest, the order between those examples was randomized for each respondent. The four figures show the number of respondents who stated 'The sentence is completely natural (under the intended reading)', 'The sentence is slightly unnatural (under the intended reading)', 'The sentence is considerably unnatural (under

the intended reading)', and 'The sentence is completely impossible (under the intended reading)', respectively.[1]

Japanese does not allow part of a compound to be left unpronounced, as shown by the contrast between (4b) and (4c); (4b) but not (4c) can be uttered as an appropriate answer to the question in (4a).

(4) a. Omoidashita?
recall-PAST
'Have (you) succeeded in recalling it?'

b. Iya, omoidasanai. <12, 2, 1, 1>
no recall-NEG-PRES
'No, (I) cannot recall (it).'

c. ??Iya, dasanai. <3, 3, 4, 6>

Given this observation, the fact that not only (3a) but also (3b) is acceptable shows that Japanese allows left-node raising of part of a compound (the string *omoi* in the present case).

Third, a non-constituent can be right-node-raised, as in (5), again an example taken from Wilder (1997), in which the non-constituent string *charged particle* has been right-node-raised.

(5) a negatively- and a positively-charged particle

A non-constituent can also be left-node-raised, as in (6b), which is arguably a result of left-node-raising the string *sugu ni omoi* in (6a).

(6) a. [Sugu ni omoidasu ka] [sugu ni omoidasanai ka] ga
[immediately recall-PRES Q] [immediately recall-NEG-PRES Q] NOM
mondai da.
problem COP-PRES
'Whether (you) can recall (it) immediately or (you) cannot recall (it) immediately is the problem.'

b. Sugu ni omoidasu ka dasanai ka ga mondai da.

Fourth, a string α can be right-node-raised out of a phrase β only if α constitutes the right periphery of β, as shown by (7), while there is no comparable restriction on leftward extraction.

[1]The *average rating* for a linguistic material L, which will be represented as $r(L)$, is defined here as $(1a+2b+3c+4d)/(a+b+c+d)$, when the questionnaire result for L is $<a,b,c,d>$. A linguistic material L that is associated with a questionnaire result is shown here with no diacritic if $1 \leq r(L) < 2$, with '?' if $2 \leq r(L) < 2.5$, with '??' if $2.5 \leq r(L) < 3$, with '?*' if $3 \leq r(L) < 3.5$, and with '*' if $3.5 \leq r(L) \leq 4$. The notion of average rating is only intended as an expedient; the way it is defined and used here is arbitrary to a certain extent.

(7)*I first offered apples and then sold peaches the immigrant from Paraguay. (from Postal (1998))

Likewise, a string α can be left-node-raised out of a phrase β only if α constitutes the left periphery of β, as shown by (8), which is the result of attempting to left-node-raise the string *omoi* in (6a).

(8)*Omoi sugu ni dasu ka sugu ni dasanai ka ga mondai da.

Fifth, when two or more constituents are right-node-raised or left-node-raised out of a phrase, the linear order between those constituents must be preserved, as shown by (9) and (10). (9) is the result of attempting to exchange the two right-node-raised expressions *charged* and *particle* in (5), and (10) is the result of attempting to exchange the two left-node-raised expressions *sugu ni* and *omoi* in (6b).

(9)*a negatively- and a positively- particle charged

(10)*Omoi sugu ni dasu ka dasanai ka ga mondai da.

Leftward extraction in English, on the other hand, is not subject to a comparable constraint, as revealed by the fact (noted in Pollard and Sag (1994, p. 171)) that a sentence like (11) is more or less acceptable; notice that the phrase *someone that stupid* precedes the phrase *how much time* whereas the gap corresponding to the former follows the gap corresponding to the latter.

(11) Someone that stupid, how much time do we really want to waste arguing with?

And sixth, the 'landing site' of a right-node-raised or left-node-raised expression must be adjacent to the coordinate structure[2] out of which it has been dislocated. Thus, RNR like (12b) is not possible, while RNR like (12a) is possible; in (12b), the 'landing site' of C is separated from the coordinate structure by F.

(12) a. [[A B C] and [D E C]] $\longrightarrow$ [[A B] and [D E]] C

b. [[A B C] and [D E C]] F $\longrightarrow$ [[A B] and [D E]] F C

This would be a puzzling restriction, if RNR and LNR were to be viewed as instances of unbounded dependency mediated by SLASH inheritance.

It has been claimed in Sabbagh (2007) that RNR like (12b) is in fact possible. This claim, however, is unfounded. The following are sentences that are cited as evidence for this claim in Sabbagh (2007).

[2]RNR and LNR can apply to a non-coordinate structure as well, but here let us restrict our attention to RNR and LNR out of a coordinate structure.

(13) Joss will sell to a library, and donate to a shelter on the same day, all of his manuscript.

(14) Jamie read a short review, and two longer reviews for the same journal, of my recent book.

According to the analysis presented in Sabbagh (2007), the expression *on the same day* in (13) and the expression *for the same journal* in (14) separate the right-node-raised expressions in these examples from the coordinate structures that they have been dislocated out of. However, that is not the only possible analysis of these sentences. The expression *on the same day* in (13) and the expression *for the same journal* in (14) could be part of the right-node-raised expressions, along with *all of his manuscript* in (13) and *of my recent book* in (14). It might also be possible to treat the expression *on the same day* in (13) and the expression *for the same journal* in (14) as part of the second conjuncts. Thus, it remains likely that RNR like (12b) is impossible. Nothing comparable is true of leftward extraction such as topicalization and relativization.

These observations all indicate that RNR and LNR are fundamentally different from phenomena that are successfully analyzed in terms of SLASH inheritance.

3 Linearization-based theories of RNR and LNR

The linearization-based theories of RNR and LNR, proposed in Yatabe (2001) and Beavers and Sag (2004), do not encounter the problems that SLASH-based theories do.

In Yatabe's theory, RNR and LNR are each claimed to come in two varieties: a purely phonological variety and a syntactic variety. The purely phonological variety of RNR and LNR is assumed to be nothing but phonological deletion; a phrase like (2) is assumed to be derived from *the input of this machine and the output of this machine* by deleting the first occurrence of *-put of this machine*.[3] On the other hand, the syntactic variety of RNR and LNR is assumed to merge two or more domain objects into one. Since the theory is coupled with a novel theory of semantic composition[4] in which domain objects rather than signs are treated as

[3]As noted in Yatabe (2004), the purely phonological type of RNR can also be taken to be responsible for a German sentence like *Peter beschreibt den, und Martin beschreibt das Quark* 'Peter describes the fresh cheese and Martin describes the quark', discussed in Hartmann (2000). The word *Quark* has two senses; with the masculine article, it refers to fresh cheese, while with the neuter article, it refers to an elementary particle. In the sentence in question, the right-node-raised expression *Quark* is a masculine noun for the first conjunct and a neuter noun for the second conjunct.

[4]Here the term *semantic composition* is being used to refer to the process through which successively larger semantic representations (such as Minimal Recursion Semantics representations) are constructed. It is not being used to refer to a process dealing with model-theoretic objects such as functions from individuals to truth-values.

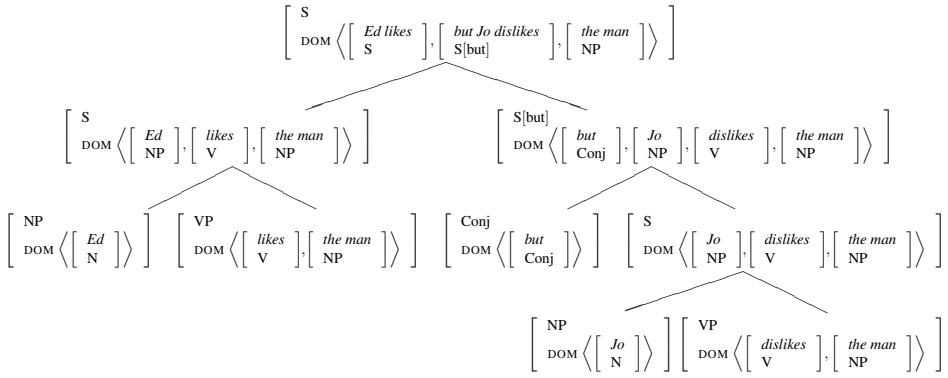

Figure 1: Syntactic RNR in Yatabe's theory

the principal units of semantic composition,[5] this means that the syntactic variety of RNR and LNR is capable of affecting the meaning of the sentences involved.[6] Figure 1 illustrates the way this theory handles the syntax of RNR in English.

In Beavers and Sag's theory, on the other hand, RNR and LNR are assumed to be essentially phonological deletion in all cases, and what they call Optional Quantifier Merger is introduced to explain the fact that RNR and LNR are capable of affecting semantic interpretation. Optional Quantifier Merger is a modification of what is proposed in Crysmann (2003), and is described as in (15).

(15) Optional Quantifier Merger: For any elided phrase denoting a generalized quantifier in the domain of either conjunct, the semantics of that phrase may optionally be identified with the semantics of its non-elided counterpart.

In both Yatabe's theory and Beavers and Sag's theory, it is expected that there should be numerous differences between RNR and LNR on the one hand and instances of leftward extraction such as topicalization and relativization on the other. Both theories presuppose what is called the Persistence Constraint in Kathol (1995), given in (16).

(16) The Persistence Constraint:
Any ordering relation that holds between domain objects α and β in one order domain must also hold between α and β in all other order domains that α and β are members of.

[5] In the proposed theory, the CONTENT values of signs represent only constructional meaning, that is, meaning that is expressed not by individual words but by grammatical constructions. Meaning that is expressed by individual words is represented in the CONTENT values of domain objects.

[6] Note, however, that it is not claimed in Yatabe (2001) that syntactic phrase structure is irrelevant in semantic composition. For instance, the theory in question is not incompatible with the reasonable and most probably correct view that the scope of an adjunct is determined on the basis of syntactic phrase structure (see for example the treatment of the semantics of the word *only* presented in Yatabe and Hayakawa (2005, Section 3)).

The Persistence Constraint captures two of the facts noted in Section 2, namely the fact that RNR and LNR are possible only from the right edge and the left edge of a phrase respectively, and the fact that the order of the two or more expressions that are right-node-raised or left-node-raised must be preserved.

The predictions of Yatabe's theory and Beavers and Sag's theory are indistinguishable in many cases, but there are two empirically testable differences between the two theories. One difference, which is syntactic in nature and is thus only indirectly related to the central topic of this paper, concerns what is called summative agreement in Yatabe (2003), a phenomenon exemplified by (17).

(17) The pilot claimed that the first nurse, and the sailor proved that the second nurse, were spies. (from Postal (1998))

Summative agreement is problematic for Beavers and Sag's account; it is not possible to analyze sentence (17) as a result of simple phonological deletion of the VP *were spies* in the first conjunct, as the VP *were spies* is in the plural form whereas its subjects (*the first nurse* and *the second nurse*) are both singular.[7] Beavers and Sag propose to deal with this problem by viewing examples like this as acceptable but ungrammatical sentences, on a par with an example like (18).

(18) One of the children are not feeling well.

Their proposal is not compelling, however. For one thing, sentence (17) does not contain a plural NP that could have tricked the performance system into accepting the plural agreement on the VP, unlike sentences like (18).[8] For another thing, their proposal is not consistent with the fact that there are languages in which summative agreement is obligatory. According to Kazenin (2002), a Russian sentence of the form (19a) is acceptable whereas a sentence of the form (19b) is not.

(19) a. Singular Subject - Object - Singular Subject - Object - Plural Verb

b.*Singular Subject - Object - Singular Subject - Object - Singular Verb

This shows that Beavers and Sag's account of sentences like (17) is not a general enough solution of the problem posed by summative agreement. Yatabe's theory, on the other hand, easily accommodates the phenomenon of summative agreement, as shown in Yatabe (2003).

[7]The phenomenon of summative agreement is problematic for analyses of RNR and LNR within Categorial Grammar too, as noted in Yatabe (2003).

[8]Beavers and Sag do not subscribe to the view (expressed in Pullum (1984) among other places) that a sentence like (18) sounds acceptable simply because there is a plural NP that could trick the performance system. However, five of the six examples of performance-based plural agreement that they discuss contain a plural NP and are thus consistent with such a view. The relative acceptability of the remaining example, namely their sentence (41c), *The pump as well as the motor are defective*, could be attributed to the possibility of reanalyzing the phrase *as well as* as a conjunction, and hence does not contradict the view in question either.

The second empirical difference between the two theories is a semantic one. In Beavers and Sag's theory, the only semantic effect that RNR and LNR can have is reduction of the number of quantifiers involved; neither RNR nor LNR is expected to be capable of nullifying scope island effects. In contrast, in Yatabe's theory, it is expected that RNR and LNR might be able to nullify some scope island effects; since this theory implies (roughly) that a quantifier α is not retrieved from quantifier storage (i.e. it is not assigned a scope) until the domain object that represents α is merged with some other domain object(s) by the total or partial compaction operation, a syntactically right-node-raised or left-node-raised quantifier is predicted to have a tendency to be assigned a wide scope, possibly a scope that it would not have been able to be associated with had it not been syntactically right-node-raised or left-node-raised.

It is claimed in Yatabe (2001) that LNR in Japanese is indeed capable of nullifying scope island effects. However, the only evidence adduced for this claim in that paper is the author's acceptability judgments; evidence of a more objective nature is clearly called for.

4 LNR out of scope islands

Two questionnaire studies were conducted in order to test whether LNR in Japanese is capable of overriding scope island effects. In the studies, students at the University of Tokyo who were linguistically naive native speakers of Japanese were asked to judge the acceptability of sentence-interpretation pairs using the following 4-point scale:
1 = "It is completely natural to interpret the sentence in the intended way."
2 = "It is slightly unnatural to interpret the sentence in the intended way."
3 = "It is considerably unnatural to interpret the sentence in the intended way."
4 = "It is completely impossible to interpret the sentence in the intended way."
The experimental sentence-interpretation pairs were sent to the participants via email together with various non-experimental sentence-interpretation pairs whose status was also to be judged. The order of the sentence-interpretation pairs was randomized for each participant. The sentences were all presented without any use of punctuations; it was stated in the preamble of the questionnaires that the sentences the participants were going to read did not have any punctuations in it. The respondents were compensated for their time.

4.1 Questionnaire 1

The following were the experimental sentence-interpretation pairs in the first questionnaire, in which 40 people participated. The participants were divided into two groups; one group judged the acceptability of each intended interpretation of (20) and (21), the other group judged the acceptability of each intended interpretation of (22) and (23), and both groups judged the acceptability of the same twelve filler

sentence-interpretation pairs.

(20) [Shichi-nin-ijô no kokkaigiin no] [jikihitsu no] shomei o
[seven or more GEN congressperson GEN] [hand-written] signature ACC
morau ka giin-bajji o kashite morau ka
obtain-PRES or congressional badge ACC lend-GER 'receive'-PRES or
shinakereba naranai
do-NEG-PROV 'become'-NEG-PRES

Interpretation 1 'We have to take one or the other of the following two actions: (i) obtaining seven or more congresspeople's hand-written signatures and (ii) borrowing seven or more congresspeople's congressional badges.'

Interpretation 2 'For each of seven or more congresspeople, we have to either obtain that congressperson's hand-written signature or borrow that congressperson's congressional badge. One way to do this would be to obtain three congresspeople's hand-written signatures and borrow four congresspeople's congressional badges.'

(21) [Jikihitsu no] [shichi-nin-ijô no kokkaigiin no] shomei o
[hand-written] [seven or more GEN congressperson GEN] signature ACC
morau ka giin-bajji o kashite morau ka
obtain-PRES or congressional badge ACC lend-GER 'receive'-PRES or
shinakereba naranai
do-NEG-PROV 'become'-NEG-PRES

Interpretation 1 (Same as Interpretation 1 of (20).)

Interpretation 2 (Same as Interpretation 2 of (20).)

(22) [Yattsu-ijô no chiten no] [kyô shôgo no jiten de no]
[eight or more GEN location GEN] [today noon GEN moment at GEN]
kion o keisoku suru ka kinô no saikô kion
temperature ACC measure-PRES or yesterday GEN maximum temperature
o toiawaseru ka shinakereba naranai
ACC inquire-PRES or do-NEG-PROV 'become'-NEG-PRES

Interpretation 1 'We have to take one or the other of the following two actions: (i) measuring the temperature at eight or more locations at noon today and (ii) inquiring about yesterday's maximum temperature at eight or more locations.'

Interpretation 2 'For each of eight or more locations, we have to either measure the temperature at that location at noon today or inquire about yesterday's maximum temperature at that location. One way to do this would be to measure the temperature at noon today at three locations and inquire about yesterday's maximum temperature at five locations.'

(23) [Kyô shôgo no jiten de no] [yattsu-ijô no chiten no]
[today noon GEN moment at GEN] [eight or more GEN location GEN]
kion o keisoku suru ka kinô no saikô kion
temperature ACC measure-PRES or yesterday GEN maximum temperature
o toiawaseru ka shinakereba naranai
ACC inquire-PRES or do-NEG-PROV 'become'-NEG-PRES

Interpretation 1 (Same as Interpretation 1 of (22).)

Interpretation 2 (Same as Interpretation 2 of (22).)

A phrase of the form *X ka Y ka* means 'either X or Y', and the phrase *shinakereba naranai* means 'must'. The only difference between (20) and (21) is the order between the two prenominal expressions *shichi-nin-ijô no kokkaigiin no* and *jikihitsu no*. In (20), the quantificational expression *shichi-nin-ijô no kokkaigiin no* 'seven or more congresspeople's' is at the left edge of the coordinate structure, and can be interpreted as having been left-node-raised out of the two conjuncts (the first conjunct which means "to obtain seven or more congresspeople's hand-written signatures" and the second conjunct which means "to borrow seven or more congresspeople's congressional badges"). In (21), on the other hand, the quantificational expression *shichi-nin-ijô no kokkaigiin no* is embedded within the first conjunct; it cannot be interpreted as having been left-node-raised out of the two conjuncts, since it is preceded by a phrase that is unambiguously a part of the first conjunct (*jikihitsu no*). In both cases, Interpretation 1 is the reading in which the quantificational expression *shichi-nin-ijô no kokkaigiin no* takes narrow scope within the first conjunct, and Interpretation 2 is the reading in which the quantificational expression takes wide scope over the entire coordinate structure.

Yatabe's theory and Beavers and Sag's theory both predict that Interpretation 1 of (20) and Interpretation 1 of (21) must be possible, because the noun *giin-bajji* 'congressional badge' in the second conjuncts of these sentences can be taken to have a syntactically unrealized possessor slot (or, equivalently, a syntactically realized possessor slot that is filled by a zero pronoun), which can be interpreted as meaning 'seven or more congresspeople's'. In the case of (20), there is one more way to obtain Interpretation 1, in both theories. In Yatabe's theory, the interpretation can be obtained by analyzing the sentence as a result of applying the purely phonological, semantically inert variety of LNR to the quantifier *shichi-nin-ijô no kokkaigiin no*. In Beavers and Sag's theory, the interpretation can likewise be obtained by positing that the LNR involved in generating the sentence was not accompanied by an application of Optional Quantifier Merger.

On the assumption that conjuncts are scope islands in Japanese or, to be somewhat more precise, on the assumption that a domain object corresponding to a conjunct (such as the domain object in Figure 1 whose PHON value is *Ed likes*) cannot be associated with a non-empty quantifier storage in Japanese, Yatabe's theory predicts that Interpretation 2 should be possible in (20) but not in (21), because the quantifier can be interpreted as having been left-node-raised out of the

first conjunct only in (20). On the other hand, if conjuncts are not scope islands, the theory predicts that there should not be any difference in acceptability between Interpretation 2 of (20) and Interpretation 2 of (21).

On the other hand, Beavers and Sag's theory arguably predicts that there should not be any difference in acceptability between Interpretation 2 of example (20) and Interpretation 2 of example (21) irrespective of whether conjuncts are scope islands in Japanese; the quantifier inside the first conjunct must be able to take wide scope over the entire coordinate structure in both (20) and (21) if conjuncts are not scope islands, and it must not be able to take such wide scope in either (20) or (21) if conjuncts are scope islands. Note that all that is necessary to achieve Interpretation 2 of (21) within Beavers and Sag's theory is for the quantifier *shichi-nin-ijô no kokkaigiin no* 'seven or more congresspeople's' in the first conjunct to be able to take scope over the entire coordinate structure; it is not necessary for the quantifier to be able to bind the unpronounced possessor slot of the noun *giin-bajji* 'congressional badge' in the second conjunct, because the noun *giin-bajji* in the second conjunct can be interpreted as meaning 'a congressional badge' (as opposed to 'his or her congressional badge'), and Interpretation 2 of (21) will result under such an interpretation as well.

The structure of (22) and (23) is analogous to that of (20) and (21) respectively. The only difference between (22) and (23) is the order between the two prenominal expressions *yattsu-ijô no chiten no* 'of eight or more locations' and *kyô shôgo no jiten de no* 'at noon today'. In (22), the quantificational expression *yattsu-ijô no chiten no* 'of eight or more locations' is at the left edge of the coordinate structure, and can be interpreted as having been left-node-raised out of the two conjuncts (the first conjunct which means "to measure the temperature at eight or more locations at noon today" and the second conjunct which means "to inquire about yesterday's maximum temperature at eight or more locations"). In (23), on the other hand, the quantificational expression *yattsu-ijô no chiten no* is embedded within the first conjunct; it cannot be interpreted as having been left-node-raised out of the two conjuncts, since it is preceded by a phrase that is unambiguously a part of the first conjunct (*kyô shôgo no jiten de no*). The predictions of the two theories concerning (22) and (23) are thus parallel to those discussed in relation to (20) and (21).

The result of this questionnaire is summarized in Table 1. In the column named *Number of each rating*, the figures in each 4-tuple represent the numbers of participants whose responses were 1 ("completely natural"), 2 ("slightly unnatural"), 3 ("considerably unnatural"), and 4 ("completely impossible") respectively. Interpretation 2 of sentence (20) was judged to be significantly more acceptable than Interpretation 2 of sentence (21) ($T = 17.5$, $n = 16$, $p < 0.01$). Likewise, Interpretation 2 of sentence (22) was judged to be significantly more acceptable than Interpretation 2 of sentence (23) ($T = 21$, $n = 13$, $p < 0.05$). Also, Interpretation 2 of sentence (21) and Interpretation 2 of (23) were the only cases where the mean rating was larger than 2.5; the other sentence-interpretation pairs were judged to be more acceptable than not. (The mean rating can range from 1 ("completely natural") to 4 ("completely impossible").)

	Interpretation	Number of each rating	Mean rating
Sentence (20)	1	<12, 5, 2, 1>	1.60
	2	<7, 6, 4, 3>	2.15
Sentence (21)	1	<5, 7, 5, 3>	2.30
	2	<1, 3, 10, 6>	3.05
Sentence (22)	1	<14, 5, 1, 0>	1.35
	2	<6, 3, 7, 4>	2.45
Sentence (23)	1	<3, 9, 5, 3>	2.40
	2	<2, 5, 4, 9>	3.00

Table 1: The result of Questionnaire 1

These results are all consistent with the predictions of Yatabe's theory and, at first blush, seem to contradict Beavers and Sag's theory. However, it turns out that these results alone do not allow us to choose between the two theories. Since (21) and (23) were judged to be worse than (20) and (22) respectively under Interpretation 1 as well as under Interpretation 2, the following possibility arises; the reason Interpretation 2 of (21) and Interpretation 2 of (23) were judged to be relatively unacceptable might have been simply that (21) and (23) are syntactically awkward compared to (20) and (22) and that a wide-scope reading like Interpretation 2 of these sentences tends to be harder to obtain compared to a narrow-scope reading like Interpretation 1. Such an explanation is consistent not just with Yatabe's theory but also with Beavers and Sag's theory.

The results above, however, place a constraint on Beavers and Sag's theory. In order for their theory to be consistent with these results, it has to be assumed that a conjunct is not a strong scope island in Japanese, because otherwise Interpretation 2 of (20) and Interpretation 2 of (22) would both be wrongly predicted to be impossible.

4.2 Questionnaire 2

The following were the experimental sentence-interpretation pairs in the second questionnaire, in which 14 people participated. All 14 participants rated all four of the experimental sentence-interpretation pairs, as well as seven filler sentence-interpretation pairs.

(24) Shichi-nin-ijô no kokkaigiin ga jinin suru ka kyôjû ni
seven or more GEN congressperson NOM resign-PRES or by the end of today
jûman-en o yôi suru ka shinakereba naranai
100,000 yen ACC prepare-PRES or do-NEG-PROV 'become'-NEG-PRES

Interpretation 1 'One or the other of the following two events must take place: (i) an event in which seven or more congresspeople resign and (ii) an event in which we prepare 100,000 yen by the end of today.'

Interpretation 2 'Seven or more congresspeople must each take one or the other of the following two actions: (i) resigning and (ii) preparing 100,000 yen by the end of today. This requirement will be met if, say, four congresspeople resign and three congresspeople prepare, by the end of today, 100,000 yen each, totaling 300,000 yen.'

(25) [Shichi-nin-ijô no kokkaigiin no jikihitsu no shomei o
[seven or more GEN congressperson GEN hand-written signature ACC
morau ka] [kyôjû ni jûman-en o yôi suru ka]
obtain-PRES or] [by the end of today 100,000 yen ACC prepare-PRES or]
shinakereba naranai
do-NEG-PROV 'become'-NEG-PRES

Interpretation 1 'We have to take one or the other of the following two actions: (i) obtaining seven or more congresspeople's hand-written signatures and (ii) preparing 100,000 yen by the end of today.'

Interpretation 2 'For each of seven or more congresspeople, we have to either obtain that congressperson's hand-written signature or prepare 100,000 yen by the end of today. One way to do this would be to obtain four congresspeople's hand-written signatures and prepare 300,000 yen by the end of today.'

Interpretation 1 of (24) results when the sentence is interpreted as involving coordination of two sentences, the second of which lacks an overt subject NP, and Interpretation 2 of (24) results when it is interpreted as involving two conjoined verb phrases whose common subject is the sentence-initial NP, meaning 'seven or more congresspeople'. On the other hand, (25) is a sentence that unambiguously involves coordination of two verb phrases, the first of which contains a quantificational NP meaning 'seven or more congresspeople'. Neither sentence involves LNR. The first ten words of (25), which constitute the first conjunct in the sentence, are identical to the first ten words of (20), and the rest of (25) is identical to the last nine words of (24).

Yatabe's theory and Beavers and Sag's theory both predict that (24) should be acceptable under Interpretation 1 as well as under Interpretation 2. On the other hand, the predictions of the two theories diverge with regard to (25), as long as Yatabe's theory is coupled with the assumption that a conjunct is a scope island in Japanese. Beavers and Sag's theory predicts that Interpretation 1 and Interpretation 2 of (25) should both be possible, partly because a conjunct in Japanese cannot be assumed to be a strong scope island in their theory, as noted above at the end of subsection 4.1. Yatabe's theory also predicts that Interpretation 1 of (25) should be possible, but, on the assumption that a conjunct is a scope island in Japanese, it predicts that Interpretation 2 of (25) should be impossible.

There is one complication that needs to be considered before we can be certain that Beavers and Sag's theory predicts that Interpretation 2 of (25) must be acceptable. As discussed in Fox (2000), in a multidimensional analysis of coordination,

	Interpretation	Number of each rating	Mean rating
Sentence (24)	1	<7, 2, 4, 1>	1.93
	2	<5, 3, 5, 1>	2.14
Sentence (25)	1	<13, 1, 0, 0>	1.07
	2	<1, 0, 4, 9>	3.50

Table 2: The result of Questionnaire 2

in which a sentence like (26) is taken to consist of two components (27a) and (27b), any attempt to let the quantifier in a sentence like (25) or (26) take wide scope over the entire coordinate structure necessarily results in vacuous quantification in the second component, as there is nothing in the second conjunct that is coindexed with the quantifier.[9]

(26) We have to either obtain seven or more congresspeople's hand-written signatures or prepare 100,000 yen by the end of today.

(27) a. We have to obtain seven or more congresspeople's hand-written signatures.

b. We have to prepare 100,000 yen by the end of today.

Thus, if a multidimensional analysis of coordination is adopted, Interpretation 2 of (25) is expected to be unacceptable due to the occurrence of vacuous quantification, irrespective of how the other aspects of the sentence are analyzed. This consideration, however, does not affect the predictions made by Beavers and Sag's theory, since it is not possible to combine Beavers and Sag's theory with a multidimensional analysis of coordination. Therefore it is safe to conclude that Yatabe's theory and Beavers and Sag's theory make different predictions regarding Interpretation 2 of (25), as long as the former is coupled with the assumption that conjuncts are scope islands in Japanese.

The result of Questionnaire 2 is summarized in Table 2. As in Table 1, in the column named *Number of each rating*, the figures in each 4-tuple represent the numbers of participants whose responses were 1 ("completely natural"), 2 ("slightly unnatural"), 3 ("considerably unnatural"), and 4 ("completely impossible") respectively. The mean rating for Interpretation 2 of (25) was greater than 2.5, whereas the mean rating for the other three sentence-interpretation pairs was less than 2.5. The Wilcoxon signed-rank test revealed that Interpretation 2 of (25) was significantly less acceptable than Interpretation 2 of (24) ($T = 0$, $n = 10$, $p < 0.001$).[10]

[9] Fox (2000) attributes this observation to Eddy Ruys's 1993 doctoral dissertation, submitted to Universiteit Utrecht.

[10] Likewise, the Mann-Whitney test showed that Interpretation 2 of (25) was significantly less acceptable than Interpretation 2 of (20) ($U = 50$, $n_1 = 14$, $n_2 = 20$, $p < 0.001$). It has to be conceded,

This result is consistent with the prediction that Yatabe's theory makes when coupled with the assumption that conjuncts are scope islands in Japanese. It is not compatible with Beavers and Sag's theory; since Interpretation 1 of (25) is perfectly acceptable (unlike Interpretation 1 of (21) and Interpretation 1 of (23)), it is not possible to attribute the low acceptability of Interpretation 2 of (25) to the syntactic awkwardness of the sentence.

5 Comparison of Japanese and English

In this section, it will be examined whether the analysis defended for Japanese in the previous section can be carried over to English. It turns out that the pattern of facts seen in English is a little more complicated than the pattern of facts seen in Japanese.

There are facts which, at first blush, appear to demonstrate that something analogous to what has been claimed for Japanese above is true for English as well. For example, Sabbagh (2007) notes that there is a scope ambiguity involving multiple quantifiers in the case of (28) but not in the case of (29).

(28) Some nurse gave a flu shot to, and administered a blood test for, every patient who was admitted last night.

(29) Some nurse gave a flu shot to every patient, and administered a blood test for every patient.

(28) has two readings, namely a reading in which the universal quantifier *every patient who was admitted last night* takes wide scope over the existential quantifier *some nurse* and another reading in which the scope relation is reversed. Under the former reading, the sentence means that, for each patient, there was a possibly different nurse who gave him or her a flu shot and administered a blood test for him or her. Under the latter reading, the sentence means that there was a certain nurse who gave flu shots and administered blood tests for all patients. In contrast, (29) only has a reading in which the existential quantifier takes scope over the two universal quantifiers. One way to explain this observation in a theory like that proposed in Yatabe (2001) would be to say that conjuncts are scope islands in English and that RNR can nullify such scope islands. On the other hand, there is no obvious way to deal with this observation within Beavers and Sag's theory. The two readings of (28) could be generated by the mechanism of Optional Quantifier Merger, but an account along this line arguably prevents us from postulating that the VP conjuncts in sentences like (28) and (29) are scope islands, thus making it difficult to capture the fact that the universal quantifiers in (29) cannot take wide scope over the existential quantifier.

however, that there is a possibility that this difference in acceptability is merely a result of the two sentence-interpretation pairs being part of different questionnaires and being surrounded by different sentence-interpretation pairs.

Although this observation appears to show that English is quite similar to Japanese in the relevant respects, there is nevertheless an important difference between the two: while conjuncts invariably function as scope islands in Japanese, conjuncts in English function as scope islands only under certain circumstances.

Fox (2000, Section 2.3) discusses various English sentences in which conjuncts do not seem to be functioning as scope islands. (30) and (31) are two of his examples.[11]

(30) A (different) student [likes every professor$_i$] and [wants him$_i$ to be on his committee].

(31) John can love three of the women he knows. However, he can [love only one of them] and [expect her to love him back].

According to Fox, in (30), the universal quantifier *every professor* in the first conjunct can take scope over the existential quantifier *a (different) student* outside the coordinate structure and bind the pronoun *him* in the second conjunct. Likewise, in (31), the NP *only one of them* in the first conjunct in the second sentence can bind the pronoun *her* in the second conjunct, thus preventing the discourse from becoming incoherent.

In fact, Fox's discussion is not fully convincing. According to one school of thought, what seems to be VPs conjoined by the word *and* in English may sometimes consist of a head and one or more adjuncts (see Pullum (1990)), without constituting a real coordinate structure. In a sentence like (32), it does seem reasonable to analyze the string *go and get the paper* as something other than a coordinate structure, and it is possible that an analogous analysis is appropriate for some of the other cases which on the surface appear to involve VPs conjoined by *and*.

(32) I told you to go and get the paper.

Given this possibility, sentences like (30) and (31) do not establish that conjuncts in English are not always scope islands, as they both involve two VPs seemingly conjoined by *and*.

However, there are two kinds of observations reported in the literature that demonstrate convincingly that conjuncts do not always function as scope islands in English.

First, Keshet (2007) observes that in (33) the universal quantifier *every girl in this class* in the first conjunct can bind the pronoun *her* in the second conjunct.

(33) Billy [wants to date every girl in this class$_i$] or [has already asked her$_i$ out].

The intended interpretation of this sentence is somewhat redundant, making the example less than optimal, but an example like (34) shows that Keshet's observation is valid.

[11] Fox attributes the observation exemplified by (30) to Ruys (see footnote 9).

(34) Billy has (either) [sent a letter to every congresswoman] or [talked to her directly].

Irrespective of whether the word *either* is present or not, (34) can mean that every congresswoman was either sent a letter or talked to by Billy. This indicates that the quantifier inside the first conjunct can take scope over the entire coordinate structure and bind the pronoun in the second conjunct. In an example like this, in which the VPs are conjoined not by *and* but by *or*, there is little doubt that what is involved is real coordination.

This contrasts with the situation in Japanese; the sentence in (35), which is a rather faithful Japanese translation of sentence (34), clearly does not have the interpretation in which the quantifier in the first conjunct takes scope over the disjunction. In other words, the sentence cannot mean that every one of the congresspeople has already been sent a letter or directly talked to by Billy.

(35) [Birî wa], [tegami o [kokkaigiin no daremo ni] okuru
[Billy TOP] [letter ACC [congressperson GEN every one DAT] send-PRES
ka], [chokusetsu hanasu ka] shita.
or] [directly talk-PRES or] do-PAST
'Billy has sent a letter to every one of the congresspeople or talked to him or her.'

The reading that assigns wide scope to the conjunct-internal quantifier is also robustly unavailable in (36), which is the result of replacing the NP *kokkaigiin no daremo* in (35) with the NP *shichi-nin-ijô no kokkaigiin*, which is used in (20), (21), (24), and (25) as well.

(36) [Birî wa], [tegami o [shichi-nin-ijô no kokkaigiin ni]
[Billy TOP] [letter ACC [seven or more GEN congressperson DAT]
okuru ka], [chokusetsu hanasu ka] shita.
send-PRES or] [directly talk-PRES or] do-PAST
'Billy has sent a letter to seven or more congresspeople or talked to them.'

Thus, this is likely to be a genuine difference between the two languages.

Second, sentences like (37), discussed in Carpenter (1997, p. 325) and Chaves (2005), also provide potential evidence that conjuncts are not always scope islands in English.

(37) Every student and his or her supervisor met.

In this sentence, the predicate requires a group of people as opposed to a single person as its subject argument, so an analysis that treats the entire subject NP *every student and his or her supervisor* as a quantifier is not plausible if not inconceivable. It seems more reasonable to view the initial conjunct *every student* as the

sole quantifier in the sentence and to allow it to take scope over the entire sentence. A more complicated example like *Every student and his or her supervisor and every lawyer and his or her client met*, in which the quantifiers involved are proper subparts of larger conjuncts, seems to show the same pattern. Since what is involved here is not apparent VP coordination but NP coordination and is thus impossible to reanalyze as something other than coordination, examples like these show, more convincingly than examples like (30) and (31) do, that conjuncts are not necessarily scope islands in English.

The fact that not all conjuncts are scope islands necessitates a modification to the theory described in Yatabe (2001). The theory stipulates (via constraints imposed on the relevant H-CONS values by the definition of total compaction given in (28) of Yatabe (2001)) that, when some domain objects are compacted into a single, larger domain object, all the quantifiers properly contained in the original smaller domain objects must take scope inside the resulting, larger domain object. In conjunction with the assumption (stated in (30e) of Yatabe (2001)) that conjuncts must always be totally compacted, this stipulation entails that conjuncts are always scope islands. Obviously, the stipulation must be replaced by a less stringent one at least in the case of English.

However, none of the English facts considered in this section invalidates the claims made in Section 4 above. All the arguments in Section 4 are based on Japanese facts, and therefore are not affected by findings about coordination in English. What has been shown in this section is that the definition of compaction proposed in Yatabe (2001) needs to be modified in order to accommodate the fact that conjuncts are not always scope islands in English.

6 Summary

The result of questionnaire studies have been presented which shows that conjuncts are scope islands in Japanese and that LNR can nullify such scope islands. This finding favors the theory advanced in Yatabe (2001), which entails that RNR and LNR can alter the scope of quantifiers, over the theory proposed in Beavers and Sag (2004), which entails that the only semantic effect that RNR and LNR can have is reduction of the number of quantifiers involved. Additionally, the way quantification and coordination interact in English was examined and was found to be slightly different from the way they interact in Japanese.

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