CONDITIONS ON JAPANESE PHRASE STRUCTURE:
FROM MORPHOLOGY TO PRAGMATICS *

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1. Introduction

The elimination of phrase structure rules in favor of X’-theory was made possible by proposals of independent principles that yield much of the information stipulated in the formulation of those rules. It is currently assumed in the Minimalist research that phrase structure is constructed by the minimal operation Merge, which takes two syntactic objects and forms their union. (See Chomsky 1995a, 2012.) Needless to say, Merge, taken by itself, vastly overgenerates. It is then examined how certain derivations crash and fail to generate outputs. It is also assumed that some derivations converge, but send information to the C-I or P-A interface that can only be interpreted as gibberish. The purpose of this paper is to examine four phenomena in Japanese that might fall under the latter case.

The phenomena that I take up are (i) the uniqueness condition on modals, (ii) the transitivity harmony phenomenon on complex verb formation, (iii) the hierarchy of complementizers, and (iv) the distributions of discourse particles. The following section concerns modals. Ueda (2007), among others, shows that a Japanese clause can contain at most one modal. I argue that this should be attributed to the selectional properties of the modals. Many are verbal suffixes and morphologically select V or V-v (m-selection). The others semantically select T (s-selection). Then, if a modal merges with a ModalP to yield a structure with two modals, a problem arises either with morphology or with s-selection. In Section 3, I discuss what Kageyama (1993) calls lexical complex verbs, instantiated in (1).

(1) Taroo-ga ana-ni suberi-oti-ta
    Taroo-NOM hole-to slip-fall-Past
‘Taroo slipped and fell into a hole’

He demonstrates that those complex verbs must consist of two verbs that are uniform with respect to the presence/absence of an external θ-role. For example, an unergative verb can combine with a transitive verb or with another unergative verb, but not with an unaccusative verb. I first argue that a characteristic property of those complex verbs is that each of the

* I would like to thank Tomoko Haraguchi for helpful discussions. Section 2 is based on discussions with her, and Section 5 is a summary of our joint paper, Saito and Haraguchi (2012). I also benefited from the comments and suggestions of many other people, including Norbert Hornstein, Richie Kayne, Hideki Kishimoto, Keiko Murasugi, Paul Portner, Ian Roberts, and Kensuke Takita.
component verbs independently participates in the selectional relations in the syntax. Then, I show that Kageyama’s generalization follows from the s-selection requirements of v*/v.

I turn to the hierarchy of complementizers in Section 4. It is shown in Saito (2012) that the three complementizers no, ka and to are in the hierarchical relation no (Finite) < ka (Force-question) < to (Report), as illustrated in (2).

(2) Taroo-wa [CP [CP kare-no imooto-ga soko-ni i-ta (no)] ka] (to)] minna-ni
Taroo-TOP he-GEN sister-NOM there-at be-Past no ka to all-DAT
inquire-ta

‘Taroo asked everyone if his sister was there’

I suggest that this hierarchy reflects the semantics of those complementizers as well as the s-selection requirement of no. Section 5 concerns discourse particles as in (3).

(3) Hanako-wa soko-ni i-ta (wa) (yo) (ne)
Hanako-TOP there-at be-Past wa yo ne

‘Hanako was there, wasn’t she?’

These discourse particles are associated with specific speech acts; wa and yo are employed for assertion and ne solicits response. As discussed by Endo (2010), among others, they too exhibit a hierarchy. For example, the three particles in (3) must appear in the order indicated. I argue, along the lines of Saito and Haraguchi (2012), that wa occupies the lowest position as it s-selects T and that ne must follow yo for the composit speech act to be coherent.

If the discussion in this paper is on the right track, Japanese phrase structure is heavily constrained by morphology and s-selection, as well as by semantic and speech act compatibility. This is observed in a wide range of phenomena from complex verbs to discourse particles. There is no need to stipulate specific constraints or to postulate specific hierarchical structures to capture the observed generalizations.

2. The Uniqueness Condition on Modals in Japanese

In the Japanese syntax literature, ‘modal’ often refers to a category of the clause-final elements that express modality or force and do not carry tense. Ueda (2007) classifies them in the two groups shown in (4).

(4) a. E(pitemic)-modals: daroo (surmise), desyoo (formal surmise), mai (negative surmise)

b. U(utterance)-modals: ro/e (imperative), (i)nasai (formal imperative), na (negative imperative), yoo (invitation), (i)masyoo (formal invitation), yoo (volition), mai (negative volition)
She assumes the hierarchy in (5), and at the same time, observes that two modals cannot co-occur in the same clause. The observation is confirmed by the examples in (6).

(5) \[ \text{U-modal} [ \text{E-modalP} [ \text{E-modalP} [ \text{TP} \ldots \text{T} ] \text{E-modal} ] \text{U-modal} ] \]

(6) a. Kimi-wa soko-e ik-u daroo (*na) you-TOP there-to go-Pres. will don’t ‘Don’t go there (Don’t be going there)’

b. Taroo-wa soko-e ik-u mai (*daroo) Taroo-TOP there-to go-Pres. won’t will ‘Taroo won’t go there (I guess Taroo won’t go there)’

I argue in this section that this uniqueness condition on modals follows from their lexical properties.¹

It should be noted here that English modals exhibit a similar uniqueness condition. Thus, (7a) is totally out although it is synonymous with the grammatical (7b).

(7) a. *John may can solve the problem

b. John may be able to solve the problem

It has long been observed that English modals can occur only in finite contexts and hence, cannot follow another modal. This suggests that they have a morphological requirement to merge with an affixal tense. I assume that a similar approach should be pursued for the parallel case in Japanese. Yet, the situation is slightly different as Japanese modals, by definition, do not carry tense.

First, it seems plausible that all the modals in (4) take propositional complements. Propositions can take the syntactic forms of a vP (as in small clauses), a TP and a ModalP, for example. Then, this by itself does not exclude the multiple occurrences of modals in (6). However, each modal has additional lexical requirements. Let’s examine the imperative ro/e first. This element is a suffix that attaches to verb stems. As shown in (8), ro is employed for verb stems that end in vowels and e for those that end in consonants.

(8) a. Taroo-wa sore-o tabe-ro Taroo-TOP it-ACC eat-Imp.

‘Taroo, eat it’

¹ The material in this section developed out of discussions with Tomoko Haraguchi over the last couple of years. See Haraguchi (2012) for an analysis that is different but shares the same general approach.
b. Taroo-wa soko-ni ik-e
   Taroo-TOP there-to go-Imp.

   ‘Taroo, go there’

The suffixal nature of ro/e automatically limits its distribution. For example, if it takes a TP complement, then T intervenes and blocks its morphological merger with the verb, as illustrated in (9).

(9) a. *Taroo-wa sore-o tabe-ru-ro
    Taroo-TOP it-ACC eat-Pres.-Imp.

    [Diagram]

b. ModalP
    Modal’
    TP
    T’
    vP
    T
    v
    VP
    V
    tabe

The only morphologically permissible option is for it to take a vP complement. In this case, the suffix can successfully merge with V (or V-v complex). Significantly, ro/e cannot take a ModalP as its complement because the intervening modal blocks the morphological merger just like T. There is an independent reason then that ro/e cannot follow another modal.

Most of the other utterance modals have the same suffixal property. Among them are (i)nasai (formal imperative), yoo (invitation, volition), and (i)masyoo (formal invitation). Examples of (i)masyoo are shown in (10).\(^2\)

(10) a. Sore-o tabe-masyoo
    it-ACC eat-let’s

    ‘Let’s eat it’

\(^2\) The form masyoo appears when the verb stem ends in a vowel, and imasyoo when the verb stem ends in a consonant. I assume that the morpheme is imasyoo, and that the initial vowel of the suffix is deleted by the following morphophonological rule when the stem ends in a vowel:

(i) V \rightarrow \emptyset / V + \_ C
b. Soko-e ik-imasyoo
there-to go-let’s
‘Let’s go there’

I conclude then that they all must take vP complements in order to morphologically merge with V.

The epistemic modals daroo (surmise) and desyoo (formal surmise) also exhibit a regular pattern. They always take a TP complement. The head T can be present or past, and can be a verbal tense (ru/ta) or an adjectival tense (i/katta). This is shown in (11).

(11) a. Taroo-wa sore-o tabe-ru /tabe-ta daroo
Taroo-TOP it-ACC eat-Pres./eat-Past will
‘I guess Taroo eats/ate it’

b. Soko-no huyu-wa samu-i /samu-katta daroo
there-GEN winter-TOP cold-Pres./cold-Past will
‘I guess the winter there is/was cold’

(12) shows that they cannot be employed as verbal or adjectival suffixes.  

(12) a. *Taroo-wa sore-o tabe-daroo
Taroo-TOP it-ACC eat-will
‘I guess Taroo eats it’

b. *Soko-no huyu-wa samu-daroo
there-GEN winter-TOP cold-will
‘I guess the winter there is cold’

Thus, daroo (and desyoo) takes a tensed proposition as a complement and s-selects T. It follows that they cannot have a ModalP as a complement.

The situation with na (negative imperative) is slightly more complex but is similar. It takes a TP with verbal present tense as its complement. The following examples meet this condition:

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3 There is another modal karoo, which is similar in meaning to daroo but is a suffix that attaches to adjectival stems. Thus, (12b) becomes grammatical when karoo is substituted for daroo as in (i).

(i) Soko-no huyu-wa samu-karoo
there-GEN winter-TOP cold-will
‘I guess the winter there is cold’
(13) a. Taroo-wa sore-o tabe-ru na
    Taroo-TOP it-ACC eat-Pres. don’t
    ‘Taroo, don’t eat it’

    b. Taroo-wa soko-ni ik-u na
    Taroo-TOP there-to go-Pres. don’t
    ‘Taroo, don’t go there’

(14) shows that *na is not a verbal suffix and also cannot take TPs headed by past or adjectival present.

(14) a. *Taroo-wa sore-o tabe-na
    Taroo-TOP it-ACC eat-don’t
    ‘Taroo, don’t eat it’

    b. *Taroo-wa sore-o tabe-ta na
    Taroo-TOP it-ACC eat-Past don’t

    c. *Taroo-wa kimuzukasi(-i) na
    Taroo-TOP difficult(-Pres.) don’t
    ‘Taroo, don’t be difficult’

It appears then that *na selects for a specific subcategory, verbal present tense. But this requirement is plausibly s-selection rather than categorial selection (c-selection).

It is well known that verbal present tense *ru is more precisely characterized as indicating non-past. Thus, it occurs also in future contexts as in (15).

(15) a. Hanako-wa asita wani-o tabe-ru
    Hanako-NOM tomorrow alligator-ACC eat-Pres.
    ‘Hanako is going to eat alligator meat tomorrow’

    b. Taroo-wa rainen soko-ni ik-u
    Taroo-TOP next.year there-to go-Pres.
    ‘Taroo is going there next year’

This extension to future contexts, as far as I know, is not observed with the adjectival present
i. (16) is ungrammatical.

(16) a. *Taroo-wa asita kimuzukasi-i
    Taroo-TOP tomorrow difficult-Pres.
    ‘Taroo will be difficult tomorrow’
b. *Watasi-wa asita kanasi-i
   I-NOM tomorrow sad-Pres.
   ‘I will feel sad tomorrow’

Then, it can be hypothesized that *na s-selects future tense.

The distribution of *mai (negative volition, negative surmise) is similar. The following examples indicate that it s-selects future tense just like *na.

(17) a. Watasi-wa sore-o tabe-ru mai
    I-TOP it-ACC eat-Pres. won’t
    ‘I will not eat it’

b. Watasi-wa soko-ni ik-u mai
    I-TOP there-to go-Pres. won’t
    ‘I will not go there’

c. *Watasi-wa sore-o tabe-ta mai
    I-TOP it-ACC eat-Past won’t

d. *Watasi-wa kanasi(-i) mai
    I-TOP sad-Pres. won’t
    ‘I will not feel sad’

But there is another pattern observed with *mai, as in (18).

(18) Watasi-wa sore-o tabe-mai
    I-TOP it-ACC eat-won’t
    ‘I guess Taroo won’t eat it’

In this example, *mai is suffixed to the verbal stem tabe. Curiously, *mai cannot be suffixed to a verb stem that ends in a consonant. Thus, an example parallel to (18) cannot be formed with (17b). Here, I tentatively propose that the verbal suffix is not *mai but (umai). Then, the example with this suffix that corresponds to (17b) is homophonous with (17b) as in (19).

(19) Watasi-wa soko-ni ik-umai
    I-TOP there-to go-won’t
    ‘I will not go there’

This concludes the discussion of all modals listed in (4). It was shown that most of them

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4 The suffix is umai uniformly. When it is merged with tabe as in (18), the initial u is deleted according to the morphophonological rule suggested in Footnote 2.
are verbal suffixes and hence, must take vP complements so that morphology can interpret them. Daroo (surmise) and desyoo (formal surmise) s-select T and must take TP complements. A similar pattern is observed with na (negative imperative) and mai (negative volition, negative surmise), which s-select T with future tense. It follows then that no modal can take a ModalP as a complement. This accounts for the uniqueness condition on modals. Ueda (2007) groups the elements in (4) under the category Modal in part because they are in complementary distribution. But given the analysis suggested here, it is no longer clear that they form a natural class. As shown in the subsequent sections, the complementizer no and the discourse particle wa s-selects T, and hence, are in complementary distribution with the elements in (4). This, however, does not show that they belong to the category Modal. This state of affairs is expected under the bare phrase structure theory where there are no “fixed positions” for categories and Merge applies freely to two syntactic objects. It is simply that the formed structure must meet the requirements of morphology and s-selection, and this forces some elements to be in complementary distribution.

3. The Transitivity Harmony Phenomenon in Lexical Complex Verbs

This section concerns Kageyama’s (1993) generalization in (20) on Japanese lexical complex verbs.

(20) The transitivity harmony principle
In a complex verb V₁+V₂, V₁ and V₂ must be consistent with respect to the presence/absence of an external θ-role.

This generalization states that if one of the component verbs is unaccusative, the other one must also be unaccusative. Thus, it distinguishes the transitive-transitive combination in (21a) and the unaccusative-transitive combination in (21b).

(21) a. Hanako-ga Taroo-o osi-taosi-ta
Hanako-NOM Taroo-ACC push-make.fall-Past
‘Hanako pushed Taroo and made him fall’

b. *Taroo-ga kuzira-o ukabi-mi-ta
Taroo-NOM whale-ACC float-see-Past
‘A whale came to the surface and Taroo saw it’

Kageyama shows that there are three kinds of complex verbs in Japanese, aside from those that are idiosyncratically formed and pattern with simple verbs, and demonstrates that (20) applies to one of them, which he calls lexical complex verbs. I first briefly go over this qualification, and then, argue that (20) is to be explained by the s-selection requirements of

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5 Two modals can appear, although not adjacently, in a structure like V-v'-T-Modal-(X)-V-v'(T)-Modal. But the two modals belong to different clauses in this structure.
\(v^*/v\).

Kageyama (1993) first distinguishes between syntactic and lexical complex verbs. In the former, \(V_1\) and \(V_2\) project separate VPs, and \(V_2\) takes the VP headed by \(V_1\) (or the corresponding \(vP\)) as its complement. Typical examples are shown in (22), and the structure of (22a) is as in (23).\(^6\)

(22) a. Hanako-ga Taroo-ni wani-o tabe-sase-ta
    Hanako-NOM Taroo-DAT alligator-ACC eat-make-Past
    ‘Hanako made Taroo eat alligator meat’

    b. Taroo-ga wani-o tabe-hazime-ta
    Taroo-NOM alligator-ACC eat-start-Past
    ‘Taroo started to eat alligator meat’

(23)

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According to Kageyama, the complex verb *tabe-sase* is formed by the incorporation of *tabe* into *sase*.

One piece of evidence Kageyama provides for his analysis is that the pro-VP (or \(V'\)) form *soo su* ‘do so’ can substitute for the VP (or \(V'\)) headed by \(V_1\). Thus, the following examples are grammatical:

\[ (23) \]

\(\text{(23)}\) differs from the structure Kageyama posits in the details, but the crucial point is that *tabe* ‘eat’ and *sase* ‘cause’ both project VPs. It has been widely assumed since Kuroda (1965) that *sase* takes a clausal complement of some kind. The best known evidence is that in a causative sentence, the causer and the causee both qualify as the antecedent of the subject-oriented long-distance reflexive *zibun*. Here, I follow Murasugi and Hashimoto (2004), and assume that *sase* takes a \(vP\) complement.
(24) a. Hanako-ga Taroo-ni soo s-ase-ta
    Hanako-NOM Taroo-DAT so do-make-Past
        ‘Hanako made Taroo do so’

b. Taroo-ga soo si-hazime-ta
    Taroo-NOM so do-start-Past
        ‘Taroo started to do so’

Lexical complex verbs, on the other hand, are formed in the lexicon and project a single VP, according to Kageyama. Examples are provided in (25).

(25) a. Taroo-ga ana-ni suberi-oti-ta
    Taroo-NOM hole-in slip-fall-Past
        ‘Taroo slipped and fell into a hole’

b. Hanako-ga me-o naki-harasi-ta
    Hanako-NOM eye.Acc cry-make,swollen-Past
        ‘Hanako cried and made her eyelids swollen’

Although the complex verbs in (22) and (25) look similar on the surface, they pattern differently with soo su substitution. As shown in (26), soo su cannot substitute for V₁ or its projection in the case of (25).

(26) a. *Taroo-ga (ana-ni) soo si-oti-ta
    Taroo-NOM hole-in so do-fall-Past

b. *Hanako-ga (me-o) soo si-harasi-ta
    Hanako-NOM eye-ACC so do-make,swollen-Past

This is expected if the complex verb is formed in the lexicon and V₁ does not project an independent VP.

Kageyama (1993) shows that lexical complex verbs are subject to the transitivity harmony principle in (20). (27) lists some examples.


b. unergative-unergative: hasiri-yor (run-go.close.to), tobi-ori (jump-go.down),
    kake-nobor (run-climb), aruki-mawar (walk-go.around), mure-tob (form.a.flock-fly)

c. unaccusative-unaccusative: suberi-oti (slip-fall), ukabi-agar (float-rise),
    umare-kawar (be.born-change), hari-sosog (fall-flow)
d. **transitive-unergative**: moti-aruk (carry-walk), sagasi-mawar (look.for-go.around), mati-kame (wait-hold)

e. **unergative-transitive**: naki-haras (cry-make.swollen), nori-kae (ride-change), nomi-tubus (drink-waste), odori-akas (dance-stay.up.all.night)

Ungrammatical examples that do not conform to (20) are shown in (28)-(31).

(28) a. *Taroo-ga kuzira-o ukabi-mi-ta (unaccusative+transitive)*
    Taroo-NOM whale-ACC float-see-Past
    ‘A whale came to the surface and Taroo saw it’

    b. *Kareha-ga zimen-o oti-kakusi-ta*
    dead.leaf-NOM ground-ACC fall-hide-Past
    ‘Dead leaves fell and covered the ground’

(29) a. *Hanako-ga Taroo-o osi-taore-ta (transitive+unaccusative)*
    Hanako-NOM Taroo-ACC push-fall-Past
    ‘Hanako pushed Taroo and Taroo fell’

    b. *Hanako-ga wain-o nomi-yot-ta*
    Hanako-NOM wine-ACC drink-get.drunk-Past
    ‘Hanako drank wine and got drunk’

(30) a. *Kodomo-ga kaika-ni asobi-oti-ta (unergative+unaccusative)*
    child-NOM downstairs-to play-fall-Past
    ‘A child played and fell downstairs’

    b. *Hanako-ga undoozyoo-de hasiri-koron-da*
    Hanako-NOM field-in run-tumble-Past
    ‘Hanako ran and tumbled in the field’

(31) a. *Taroo-ga kaika-ni oti-ori-ta (unaccusative+unergative)*
    Taroo-NOM downstairs-to fall-go.down-Past
    ‘Taroo fell and went downstairs’

    b. *Kodomo-ga karyuu-ni nagare-oyoi-da*
    child-NOM downstream-to be.carried-swim-Past
    ‘A child was carried and swam downstream’

The transitivity harmony phenomenon, just illustrated, poses an interesting question. (20)
clearly is not a plausible candidate for a universal, innate principle on word formation. In fact, as Kageyama notes, it is not universally observed with lexical complex verbs. For example, Chinese compound verbs do not exhibit the phenomenon. The following examples are from Huang (1982):  

(32) a. Ta he-zui (jiu) le  
    he drink-get.drunk wine Asp.  
    ‘He drank (wine) and got drunk’  

b. Ta qi-lei-le lianpi ma  
    he ride-tired-Asp. two horse  
    ‘He rode two horses and got them tired’

At the same time, it is hard to imagine that Japanese speakers acquire (20) as a language-specific constraint through experience. Then, (20) is expected to be a consequence of a property of Japanese lexical complex verbs. But before going into this, let me briefly go over Kageyama’s analysis of those complex verbs and also illustrate his third kind of complex verbs.

Kageyama proposes that Japanese lexical complex verbs are formed through θ-role identification. His analysis of osi-taos ‘push-make.fall’ in (21a) is shown in (33).

(33)  

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osi-taos  
(agent₂ <theme₂>)  

(agent₁ <theme₁>)  

os  

(θ-role identification)  

taos  

(inheritance)  
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The two component verbs, osi and taos, have their own θ-roles. The agent roles of the two verbs are identified, and so are their theme roles. After this θ-role identification, the complex verb inherits the argument structure of the head, taos. Given this mechanism, the transitivity harmony principle can be construed as a constraint on θ-role identification: if a component verb has an external θ-role, it must be identified with the external θ-role of the other verb.

There is another kind of lexical complex verbs, according to Kageyama, that are formed through a different process. Typical examples are shown in (34).

(34) a. Hanako-ga Taroo-o heya-ni oi-kon-da (transitive+kom)  
    Hanako-NOM Taroo-ACC room-in chase-KOM-Past  
    ‘Taroo was chased by Hanako into the room’

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See Li (1993) for a detailed comparison of Chinese and Japanese complex verbs.
b. Taroo-ga kawa-ni tobi-kon-da (unergative+kom)
    Taroo-NOM river-to jump-KOM-Past
    ‘Taroo jumped into the river’

c. Osensui-ga umi-ni nagare-kon-da (unaccusative+kom)
    contaminated-water-NOM ocean-to flow-KOM-Past
    ‘Contaminated water flowed into the ocean’

These examples show that the verbal suffix kom can combine with any kind of verb. It appears then that complex verbs of the form V+kom are not subject to transitivity harmony. However, the issue does not arise in this case because kom, at least with its meaning in (34), is not an independent verb with its own 0-roles.8 Kom can be suffixed to the verb when the sentence indicates that a person or an object moves, and it adds the meaning that the person or the object moves to the location specified in the sentence. Kageyama, then, concludes that kom adds to the lexical-conceptual structure of the verb it is suffixed to. The complex verbs that are formed in this way are lexical complex verbs, but I refer to them as LCS complex verbs in order to distinguish them from those that are subject to transitivity harmony.

With this background, let me now consider the source of the transitivity harmony phenomenon. As noted above, the phenomenon is expected to follow as a consequence of a property of Japanese lexical complex verbs. The relevant property does not seem to be semantic. For example, there does not seem to be anything semantically wrong if lexical complex predicates are formed in ways inconsistent with transitivity harmony. The illicit ukabi-mi ‘surface-see’ and oti-kakus ‘fall-hide’ in (28) can be straightforwardly formed as in (35) under Kageyama’s analysis.

(35) a. ukabi-mi
    (agent₂ <theme₂>) ←
    ukab
    (theme₁) (agent₂ <theme₂>)
    mi
    identification
    inheritance

b. oti-kakus
    (agent₂ <theme₂>) ←
    oti
    (theme₁) (agent₂ <theme₂>)
    kakus
    identification
    inheritance

The relevant property cannot be morphological, either. Lexical complex verbs are not morphologically different from syntactic complex verbs or LCS complex verbs. Then,

8 There is an independent verb kom, which means ‘become crowded’.
transitivity harmony is likely to be a reflection of a syntactic property of lexical complex verbs.

Kageyama’s analysis illustrated in (33) suggests a curious property of those complex verbs. Because of θ-role identification, the argument structures of $V_1$ and $V_2$ are both projected in the syntax. Let us consider again (21a), repeated below as (36).

(36) Hanako-ga Taroo-o osi-taosi-ta
    Hanako-NOM Taroo-ACC push-make.fall-Past

    ‘Hanako pushed Taroo and made him fall’

In this example, Hanako is the agent of os as well as taos, and Taroo serves as the theme for both verbs. Further, Kageyama makes an important observation that the arguments of a lexical complex verb must satisfy the selectional requirements of both $V_1$ and $V_2$. His relevant examples are shown in (37)-(38) with slight modifications.

(37) a. Tuta-ga boo-ni maki-tui-ta
    ivy-NOM stick-to wind-attach-Past

    ‘An ivy twined around the stick’

b. Abura-ga kabe-ni simi-tui-ta
    oil-NOM wall-to soak-attach-Past

    ‘The wall was stained with oil’

(38) a. *Tuta-ga boo-ni simi-tui-ta
    ivy-NOM stick-to soak-attach-Past

    ‘The stick was stained with an ivy’

b. *Abura-ga kabe-ni maki-tui-ta
    oil-NOM wall-to wind-attach-Past

    ‘The oil twined around the wall’

(38a) is ungrammatical because an ivy cannot soak into a stick, and (38b) because oil cannot twine around a wall. These examples demonstrate that both $V_1$ and $V_2$ enter into selectional relations with the arguments.

If $V_1$ and $V_2$ are both visible in the selectional relations with the arguments, they must also participate in the selectional relations with $\nu^*/\nu$, as illustrated in (39) for (36).

(39) a. $[vp \text{ Taroo } [v [v osi]-v taos]]$
It has been widely assumed since Chomsky (1995b) that v* s-selects transitive/unergative V while v s-selects unaccusative V. The selectional requirement of v* is satisfied in (39b) as both os ‘push’ and taos ‘make.fall’ are transitive. But note that a lexical complex verb can meet the selectional requirements of v*/v when and only when the complex verb obeys the transitivity harmony principle in (20). Since each member of the complex verb enters into selectional relations with v*/v, v* requires that both members be transitive or unergative and v demands that both be unaccusative. Hence, the transitivity harmony follows from the s-selection requirements of v*/v.

In this section, I argued that a characteristic property of Japanese lexical complex verbs is that each component verb participates in selectional relations, and given this, Kageyama’s (1993) transitivity harmony phenomenon follows from the s-selection requirements of v*/v.\(^9\) In the following two sections, I discuss cases where semantic and speech act compatibility contributes to the well-formedness of sentences.

4. The Hierarchy of Japanese Complementizers

Japanese has three complementizers, no, ka and to, as illustrated in (40).

(40) a. Taroo-wa [cP Hanako-ga soko-ni i-ru no]-o sittei-ta
    Taroo-TOP Hanako-NOM there-in be-Pres. no-ACC know-Past
        ‘Taroo knew that Hanako was there’

b. Taroo-wa [cP Hanako-ga sono hon-o mottei-ru ka] siritagattei-ru
    Taroo-TOP Hanako-NOM that book-ACC have-Pres. ka want.to.know-Pres.
        ‘Taroo wants to know whether Hanako has that book’

c. Taroo-wa [cP Hanako-ga sono hon-o mottei-ru to] omottei-ru
    Taroo-TOP Hanako-NOM that book-ACC have-Pres. to think-Pres.
        ‘Taroo thinks that Hanako has that book’

These complementizers can co-occur as in (41), and when they do, they appear in the order indicated.

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\(^9\) The next question to be addressed is why Japanese productively employs complex verbs with this property. See Saito (to appear) for some discussion on this.
(41) Taroo-wa [CP kare-no imooto-ga soko-ni i-ta (no) ka (to)] minna-ni tazune-ta
    Taroo-TOP he-GEN sister-NOM there-at be-Past no ka to all-DAT inquire-Past
    ‘Taroo asked everyone if his sister was there’

Given this, I proposed the hierarchy in (42) in Saito (2012).

(42) [CP … [CP … [CP … Finite (no)] Force (ka)] Report (to)]

(42) predicts that the complementizer sequences in (43a) are allowed while those in (43b)
are not.

(43) a. no-ka, ka-to, no-ka-to
    b. *to-ka, ka-no, to-no, to-ka-no, ka-to-no
    c. *no-to

There is, however, one sequence, no-to in (43c), that is consistent with the hierarchy in (42)
and yet is illicit. Thus, (44) is ungrammatical.

(44) *Taroo-wa [CP kare-no imooto-ga soko-ni i-ru no to] kitaiasi-ta
    Taroo-TOP he-GEN sister-NOM there-at be-Pres. no to expect-Past
    ‘Taroo expected his sister to be there’

The purpose of this section is to provide an explanation for the hierarchy in (42), and at the
same time, to account for the exception in (43c).

It is necessary to discuss the properties of each complementizer first in order to examine
the source of their hierarchical relations. Ka is straightforward as it is the complementizer for
questions. No and to, on the other hand, require some discussion. Let’s consider to first.

To is ambiguous between a marker of direct quotation as in (45a) and a complementizer
that embeds indirect discourse as in (45b).

(45) a. Hanako-ga, “Watasi-wa tensai da,” to it-ta /omot-ta (koto)
    Hanako-NOM I-TOP genius be to say-Past/think-Past fact
    ‘(the fact that) Hanako said/thought, “I’m an genius”’

b. Hanako-ga [zibun-ga tensai da to] it-ta /omot-ta (koto)
    Hanako-NOM self-NOM genius be to say-Past/think-Past fact
    ‘(the fact that) Hanako said/thought that she is an genius’

In the latter case, it has been widely assumed that to is employed for propositional
complements as it appears when the matrix verb is a typical bridge verb like iw ‘say’ and
omow ‘think’. However, I argued in Saito (2012) that to embeds a paraphrase or report of direct discourse. Plann (1982) shows that the Spanish complementizer que has this function. What I proposed is that to is specialized for this function. One piece of evidence is that the matrix verbs that s-select to are all verbs of saying and thinking, that is, verbs that are compatible with direct quotation. A partial list of those verbs is shown in (46).


Secondly, to embeds various types of sentences just like que. To follows a question in (47a), imperative sentences in (47b-c), and an expression of invitation in (47d).\(^\text{10}\)

(47) a. Taroo-wa Ziroo-ni [CP kanozyo-ga kare-no ie-ni ku-ru ka to] tazune-ta
Taroo-TOP Ziroo-DAT she-NOM he-GEN house-to come-Pres. ka to ask-Past

‘Taroo asked Ziroo if she is coming to his house’

b. Hanako-wa Taroo-ni [CP kanozyo-no ie-ni i-ro to] meizi-ta
Hanako-TOP Taroo-DAT she-GEN house-at be-Imp. to order-Past

‘Hanako ordered Taroo to be at her house’

c. Hanako-wa Taroo-ni [CP kanozyo-no ie-ni ik-u-na to] meizi-ta
Hanako-TOP Taroo-DAT she-GEN house-to go-Pres.-don’t to order-Past

‘Hanako ordered Taroo not to go to her house’

d. Hanako-wa Taroo-o [CP kanozyo-no ie-ni ik-oo to] sasot-ta
Hanako-TOP Taroo-ACC she-GEN house-to go-let’s to invite-Past

‘Hanako invited Taroo to go to her house’

This is unexpected if to is a complementizer for propositional complements. On the other hand, the examples in (47) should be grammatical if to embeds paraphrases of direct discourse. A direct discourse, and hence its paraphrase, can be a question, an order or an invitation, in addition to a simple statement.

Then, what is the complementizer for embedded propositions in Japanese? It is argued in Saito (2012) that no is employed for this purpose. (48) is a partial list of matrix verbs that take CP complements headed by no.

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\(^{10}\) Plann (1982) demonstrates that que can take a question CP as a complement when the matrix verb is a verb of saying or thinking. She argues, based on this fact, that que can embed a paraphrase of a quotation. Rivero (1994) shows in support of Plann’s analysis that que takes an imperative complement as well.

All of these verbs take complements that express events or actions. For example, what one forgets is an event or to perform an action. What one hesitates is to perform an action and what one waits for is for an event to happen. Then, they take propositional complements.

Matsumoto (2010) argues that no is a Finite head, a hypothesis originally proposed by Hiraiwa and Ishihara (2002). If no is the complementizer for propositions, it should in principle be able to embed a ModalP, as a ModalP can stand for a proposition. However, Matsumoto observes that no s-selects T and is incompatible with modals. This is shown in (49)-(50).

(49) a. Taroo-wa [CP [TP ame-ga hur-u] no]-o kitaisi-ta
    Taroo-TOP rain -NOM fall-Pres. no-ACC expect-Past

    ‘Taroo hoped that it would rain’

       Taroo-TOP rain-NOM fall-Pres. will no-ACC expect-Past

    ‘Taroo hoped that it would rain’

(50) a. Taroo-wa [CP [TP ame-ga hur-u] no]-o yosoosi-ta
    Taroo-TOP rain-NOM fall-Pres. no-ACC predict-Past

    ‘Taroo predicted that it would rain’

       Taroo-TOP rain-NOM fall-Pres. won’t no-ACC predict-Past

    ‘Taroo predicted that it would not rain’

Finite, by definition, is closely related to Tense. Then, the fact that no s-selects T, Matsumoto (2010) argues, provides evidence that it is a Finite head.

Let us now consider the hierarchy in (42), repeated in (53), with this background.

(53) [CP ... [CP ... [CP ... Finite (no)] Force (ka)] Report (to)]

The fact that no occupies the lowest position in the hierarchy already follows from its s-selection requirement. As it s-selects T, it cannot take a CP complement. On the other hand, ka and to are not in selectional relation with any specific head. Ka, for example, merges with a syntactic object that stands for a proposition and creates a question. A proposition can be expressed as a vP, a TP, a ModalP or a CP. Ka can take a TP, a ModalP and a CP as its complement, as shown in (54).
    Taroo-TOP Hanako-NOM there-to go-Past ka all-DAT ask-Past

    ‘Taroo asked everyone if Hanako went there’

    Taroo-TOP Hanako-NOM there-to go-Pres. will ka all-DAT ask-Past

    ‘Taroo asked everyone if Hanako would go there’

    Taroo-TOP Hanako-NOM there-to go-Past no ka all-DAT ask-Past

    ‘Taroo asked everyone if Hanako went there’

(54c) is the most relevant for the hierarchy in (53), which allows the no-ka sequence. As argued above, no is the complementizer for embedded propositions and a CP headed by no stands for a proposition. Hence, ka can merge with a no-headed CP as in (54c).

The merger of vP and ka should be possible on semantic grounds but is excluded by morphology. A verb stem is a dependent morpheme and requires a suffix such as tense. As ka cannot serve as an appropriate suffix for a verb stem, it cannot take a vP complement. Also, ka cannot combine with ModalPs and CPs that do not stand for propositions. Thus, the following examples are totally ungrammatical:

    Taroo-TOP Hanako-NOM there-to go-Imp. ka all-DAT ask-Past

    Taroo-TOP Hanako-NOM there-to go-Past to ka all-DAT ask-Past

The embedded ModalP in (55a) expresses an order, and that in (55b) a paraphrase of direct discourse. These are examples of semantic incompatibility as ka requires a complement that stands for a proposition. (55b), in particular, illustrates why the complementizer sequence to-ka is impossible.

It was shown so far why no-ka is possible whereas ka-no and to-ka are not. It is necessary to review the property of to in order to examine the other combinations. It was argued above that to embeds a paraphrase of direct discourse. This complementizer, like ka, does not select any specific head, and can combine with various types of clauses as long as its semantic requirement is satisfied. It was already shown in (40c) and (47) that ka can take a TP, a CP and a ModalP as its complement. Most relevant in the present context is (47a), repeated below as (56).
(56) Taroo-wa Ziroo-ni [CP [CP kanozyo-ga kare-no ie-ni ku-ru ka] to] tazune-ta
Taroo-TOP Ziroo-DAT she-NOM he-GEN house-to come-Pres. ka to ask-Past

‘Taroo asked Ziroo if she is coming to his house’

As the paraphrased direct discourse can be a question, to can take a question CP as its complement. A direct discourse, or an utterance, can express a statement, an assertion, a question, an order, and the like. It is then not surprising that to can embed various types of clauses. Outstanding in this context is the ungrammaticality of (44), repeated below as (57).

(57) *Taroo-wa [CP kare-no iimooto-ga soko-ni i-ru no to] kitaisi-ta
Taroo-TOP he-GEN sister-NOM there-at be-Pres. no to expect-Past

‘Taroo expected his sister to be there’

This example indicates that to cannot take a no-headed CP as its complement. Recall here that no-headed CPs stand for propositions, and express events, states, actions and the like. Then, they cannot be construed as paraphrases of direct discourse. The no-to sequence is illicit also because of semantic incompatibility.

In this section, I argued that the hierarchical relation among the complementizers, no, ka and to, follows from the s-selection requirement of no and the semantics of those complementizers. No, which is the complementizer for embedded propositions, s-selects T. Hence, it occupies the lowest position in the hierarchy. Ka merges with clauses that stand for propositions and creates questions. Hence, the no-ka sequence is possible. To embeds paraphrases of direct discourse. Since the paraphrased direct discourse can be a question, the ka-to sequence is also possible. This covers all the possible combinations, no-ka, ka-to, and no-ka-to. On the other hand, the ka-no and to-no sequences are both in conflict with the s-selection requirement of no. The to-ka sequence is ruled out because a to-headed CP does not stand for a proposition. Thus, the hierarchy in (53) is precisely what is expected. The only exception to the hierarchy is that the no-to sequence is illicit. This fact too receives an account because a no-headed CP cannot express a paraphrase of direct discourse. In the following section, I turn to the distributions of sentence-final discourse particles, another phenomenon for which a hierarchy is proposed.

5. Discourse Particles and Speech Act Compatibility

Japanese is rich in sentence-final particles. Endo (2010) discusses four of them in some detail; wa, yo, ne and na. Roughly speaking, the first two are employed for assertion, and the latter two for solicitation of response. As Endo observes, their distributions are quite interesting because some of them can co-occur but only in a fixed order. For example, (58) contains three particles, and they must appear in the order indicated.
(58) Hanako-wa soko-ni i-ta (wa) (yo) (ne)
    Hanako-TOP there-at be-Past wa yo ne

    ‘Hanako was there’

In this section, I investigate the source of this hierarchy.\(^{11}\)

First, as Haraguchi (2012) shows, these particles are genuine discourse elements whose distributions are confined to matrix contexts. Thus, they cannot occur even within to-headed CPs, which embed various types of clauses as observed above.

(59) a. Hanako-wa [\[CP Taroo-wa kanozyo-no ie-ni i-ru (*wa) to] omot-ta
    Hanako-TOP Taroo-TOP she-GEN house-at be-Pres. wa to think-Past

    ‘Hanako thought that Taroo is at her house’

b. Hanako-wa [\[CP Taroo-ga kanozyo-o tasukete kure-ru (*yo) to] kitaishi-ta
    Hanako-TOP Taroo-TOP she-ACC help (for her)-Pres. yo to expect-Past

    ‘Hanako expected Taroo to help her’

Nevertheless, \textit{wa}, in particular, has an s-selection requirement. It takes a TP complement as shown in (60).\(^{12}\)

(61) a. Watasi-wa soko-ni ik-u wa / it-ta wa
    I-TOP there-to go-Pres. wa go-Past wa

    ‘I will go there / I went there’

b. Taroo-wa yasasi-i wa / yasasi-katta wa
    Taroo-TOP kind-Pres. wa kind-Past wa

    ‘Taroo is kind / Taroo was kind’

\textit{Wa} follows verbal tenses (\textit{ru/ta}) in (61a) and adjectival tenses (\textit{ikatta}) in (61b).

On the other hand, \textit{wa} cannot merge with a CP or a ModalP. (62a) shows that \textit{wa} is incompatible with a CP complement, and (62b-c) that it cannot take a ModalP as its complement.

(62) a. Taroo-wa soko-ni ik-u no (*wa)
    Taroo-TOP there-to go-Pres. no wa

    ‘Taroo will go there’

\(^{11}\) The content of this section is based on joint research with Tomoko Haraguchi and is reported in more detail in Saito and Haraguchi (2012).

\(^{12}\) \textit{Wa} is typically employed in women’s speech.
b. Taroo-wa soko-ni ik-e (*wa)
   Taroo-TOP there-to go-Imp.  wa
   ‘Taroo, go there’

c. Hanako-wa ku-ru desyoo (*wa)
   Hanako-TOP come-Pres. will  wa
   ‘Hanako will come’

Then, wa s-selects T. This predicts that wa must occupy the lowest position in a sequence of discourse particles. It indeed cannot follow any discourse particle, as shown in (63).

(63) a. Hanako-wa soko-ni i-ta yo (*wa)
   Hanako-TOP there-at be-Past yo  wa
   ‘Hanako was there’

b. Hanako-wa soko-ni i-ta ne (*wa)
   Hanako-TOP there-at be-Past ne  wa
   ‘Hanako was there, wasn’t she?’

   Although yo is also employed for assertion, it exhibits a different distribution. It allows various clause types as its complement, and as Tenny (2006) notes, it can be translated roughly as ‘I’m telling you …’ It takes TP complements in (64) and ModalP complements in (65).

(64) a. Taroo-wa soko-ni i-ru yo / i-ta yo
   Taroo-TOP there-at be-Pres. yo  be-Past yo
   ‘Taroo is there / was there’

b. Taroo-wa yasasi-i yo / yasasi-katta yo
   Taroo-TOP kind-Pres. yo  kind-Past yo
   ‘Taroo is kind / was kind’

(65) a. Taroo-wa soko-ni ik-e / ik-inasai yo
   Taroo-TOP there-to go-Imp. go-Imp. yo
   ‘Taroo, go there’

b. Soko-ni ik-oo / ik-imasyoo yo
   there-to go-Inv. go-Inv. yo
   ‘Let’s go there’

The examples in (66) show that yo can follow the complementizer no and the discourse particle wa.
(66) a. Hanako-wa soko-ni i-ru no yo
    Hanako-TOP there-at be-Pres. no yo
    ‘Hanako is there’

b. Hanako-wa soko-ni i-ru wa yo
    Hanako-TOP there-at be-Pres. wa yo
    ‘Hanako is there’

Yo clearly does not have any s-selection requirement, and given this, it is not surprising that it can follow another discourse particle.

Na and ne, which sollicit response, are similar to yo in distribution. Here, I provide some examples for ne.

(67) a. Taroo-wa yasasi-i ne
    Taroo-TOP kind-Pres. ne
    ‘Taroo is kind, isn’t he?’

b. Taroo-wa soko-ni ik-inasai ne
    Taroo-wa there-to go-Imp. ne
    ‘Taroo, go there. Will you?’

c. Soko-ni ik-imasyoo ne
    there-to go-let’s ne
    ‘Let’s go there. Shall we?’

d. Taroo-wa yasasi-i no ne
    Taroo-TOP kind-Pres. no ne
    ‘Taroo is kind, isn’t he?’

e. Taroo-wa yasasi-i wa ne
    Taroo-TOP kind-Pres. wa ne
    ‘Taroo is kind, isn’t he?’

What appears in the complement position of ne is a TP in (67a), a ModalP in (67b-c), a CP in (67d), and a sentence headed by the speech act particle wa in (67e). Thus, ne does not s-select a specific head, either.

As Keiko Murasugi observes, there is clear evidence that wa and the other discourse particles differ in selectional properties. Yo, ne and na can appear not only sentence-finally but after any major constituent. (68) illustrates this with ne.
(68) Taroo-ga ne soko-ni ne i-te ne …
Taroo-NOM ne there-at ne be-and ne

‘It’s Taroo, alright? It’s there, alright? He was there, alright? And, …’

This is consistent with the proposal that ne does not s-select any head. Wa, on the other hand, cannot be used in this way as it s-selects T.

Nevertheless, there are restrictions on the complements of yo, ne and na. For example, ne and na can follow yo, but yo cannot follow them. Further, ne and na are mutually exclusive. Relevant examples are shown in (69)-(70).

(69) a. Hanako-wa soko-ni i-ta yo ne/na
Hanako-NOM there-at be-Past yo ne/na

Hanako was there, wasn’t she?’

b. *Hanako-wa soko-ni i-ta ne/na yo
Hanako-NOM there-at be-Past ne/na yo

(70) a. *Hanako-wa soko-ni i-ta ne na
Hanako-NOM there-at be-Past ne na

Hanako was there, wasn’t she?’

b. *Hanako-wa soko-ni i-ta na ne
Hanako-NOM there-at be-Past na ne

Hanako was there, wasn’t she?’

Then, descriptively, the hierarchy in (71) obtains.

(71) [[[ TP wa] yo] ne/na]

As argued above, wa must occupy the lowest position because it s-selects T. I suggest that the rest should be accounted for in terms of the speech acts those particles yield.

First, yo is employed for assertion, and hence, its complement must be capable of expressing an assertion. The following examples demonstrate this.

(72) a. [CP Dare-ga soko-ni ik-u ka] yo
who-NOM there-to go-Pres. ka yo

‘Who will go there? = No one will go there’

b. [CP Taroo-ni nani-ga deki-ru ka] yo
Taroo-DAT what-NOM can.do-Pres. ka yo

‘What can Taroo do? = Taroo can’t do anything’
A question can be interpreted at the discourse level as a literal question or as a rhetorical question. However, when a question is embedded under yo as in (70), only the rhetorical question interpretation survives. This is expected because a rhetorical question expresses an assertion while a literal question does not. The situation is different with ne and na, which solicit response. (73a-b), unlike (72a-b), retain the ambiguity.

(73) a.  
[CP Dare-ga soko-ni ik-u ka] ne  
who-NOM there-to go-Pres. ka ne  
‘Who will go there? / (I think) No one will go there. What do you think?’

b.  
[CP Taroo-ni nani-ga deki-ru ka] ne  
Taroo-DAT what-NOM can.do-Pres. ka ne  
‘What can Taroo do? / (I think) Taroo can’t do anything. What do you think?’

This should be because a response can be solicited on a question or an assertion.

Given the observation above, it is not at all surprising that the yo-ne/na sequence is allowed while the ne/na-yo sequence is not. Yo combines with an expression of assertion and reinforces the speech act. It is then possible to solicit a response on the assertion by placing ne/na after yo. On the other hand, ne/na adds the speech act of soliciting a response. A sentence with these particles is in fact best translated as a tag question. But it was seen above that the complement of yo cannot express a literal question for the simple reason that a question cannot be asserted. Thus, the hierarchical relation between yo and ne/na is predicted from their discourse roles.

The final question to be addressed is why ne and na cannot co-occur, as was shown in (70). Although I do not have a clear-cut answer for this, I would like to make a suggestion, based on an observation in Endo (2010). Endo notes that na is appropriate when talking to oneself whereas ne is not. Let’s compare the following two examples:

(74) a.  
Dekake-ta na  
go.out-Past na  
‘It looks like she/he went out’

b.  
Dekake-ta ne  
go.out-Past ne  
‘You/she/he went out, didn’t you/he/she?’

Suppose that you go home alone and find that your roommate is not there. Then, you could utter (74a), talking to yourself. (74b) is inappropriate in this context. On the other hand, suppose that you go home with your friend. Then, you could say (74b) to your friend, referring to your roommate. Or (74b) can be addressed to your roommate when she/he comes home. This suggests that na solicits a response from the discourse participants including the
speaker, while ne seeks a response from those excluding the speaker. Na can be employed when talking to oneself, as there is a discourse participant to whom the utterance can be addressed, namely, the speaker. Ne has no function in this context. If this characterization of ne and na is correct, then they should be mutually exclusive because their discourse functions are not compatible.

6. Conclusion

As discussed in this paper, interesting constraints and hierarchies have been proposed and entertained in the recent investigation of Japanese syntax. Ueda (2007) examines Japanese modals in detail and entertains the constraint that a clause can contain at most one modal. Kageyama (1993) proposed an influential constraint on lexical complex verb formation, namely, the transitivity harmony principle in (20). Saito (2012) observes the hierarchy of Japanese complementizers in (42), repeated below in (75).

(75)  \[ \text{CP} \ldots \text{CP} \ldots \text{CP} \ldots \text{Finite (no) \ Force (ka) \ Report (to)} \]

Endo (2010), on the other hand, examines the hierarchy of discourse particles, which can be formulated as in (76).

(76)  \[ \text{[[ TP wa \ yo \ ne/na]} \]

These constraints and hierarchies constitute facts to be explained in the Minimalist syntax. The same is true of any alternative proposals at the same descriptive level.

In this paper, I explored the possibility that they are consequences of the properties of the relevant lexical items. In Section 2, I showed that Japanese modals are either suffixes or s-select T, and argued that the uniqueness condition follows from these lexical properties. In Section 3, I proposed that a characteristic property of Japanese lexical complex verbs is that their component verbs participate in selectional relations. Given this, Kageyama’s (1993) constraint on those complex verbs can be explained in terms of the s-selection requirements of \( v^* \). In Section 4, I argued that the hierarchy of complementizers in (75) is a consequence of the s-selection requirement of no and the semantics of the complementizers. Finally, in Section 5, I suggested that the discourse particles are hierarchically organized as in (76) because wa s-selects T and any other ordering of yo, ne and na causes a contradiction in the composit speech act.

The case studies reported here are by no means exhaustive. But taken together, they suggest that there is no need to postulate constraints or hierarchies for Japanese phrase structure as the relevant facts are derived from lexical properties. This supports the Minimalist hypothesis that all that is required for phrase structure building is the minimal operation, Merge.
References


