

FOCUS IN JAPANESE AND ENGLISH

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Abstract: A modular approach to the syntax and phonology of focus both in Japanese and English is proposed on the basis of Head-driven Phrase Structure Grammar and Autosegmental Metrical Theory. It is shown that stepwise derivations of information from phonology to semantics through syntax, and vice versa, are made posible by this framework. The parametrized modeling of focus can also contribute to the universal study of focus and prosody.

Keywords: Japanese, English, focus, prosody, Head-driven Phrase Structure Grammar (HPSG), Autosegmental Metrical Theory, syntax-prosody interface

1. INTRODUCTION

Prosody in Japanese and English utterances is controlled not only by phonology, but also by various factors such as the lexicon, morphology, semantics, discourse, and different parts of syntax. It serves therefore as a criterion of evaluating grammar systems in terms of their efficiency. This paper proposes a modular approach to the syntax of focus both in Japanese and English on the basis of Head-driven Phrase Structure Grammar (HPSG). Following the Typed Unification Grammar (TUG) formalism adopted in HPSG, each chunk of linguistic knowledge is represented by a module embodied as a type that is related to other modules by type inference rules.

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The advantages this method provides are twofold: first, it allows a parametrized approach to the universal modeling of the phenomena. What is common to all languages or to a set of languages is represented by types placed higher in the type hierarchy, while each language imposes additional language–specific constraints of its own as lower types. Second, it integrates information from various components. Since focus and scope can be realized nonuniformly in different languages, the common way of specification for phonology, morphology, syntax, and semantics, enabled by the TUG formalism, is extremely effective in unifying information from those components.

In the next section, I give a short introduction to the basic framework to be employed in the following sections, i.e. HPSG and Autosegmental Metrical Theory. The third section gives an account of how information on accentual phrases, the key notion in Japanese prosody, can be built up from information on various factors including foci. Section 4 aims at formulating rules for focus assignment in Japanese utterances, based on the definition of the accentual phrase given in the previous section. Then the fifth section posits rules for focus in English. In section 6, I argue that the TUG formalism makes it possible to abstract general specifications from the rules introduced in sections 4 and 5. In conclusion, the last section discusses that the TUG framework is in fact suitable for resolving the issues addressed in this paper.

2. FRAMEWORK FOR THE APPROACH

Head–driven Phrase Structure Grammar (HPSG; Pollard and Sag 1987, 1994) is a theory of grammar that has been developed under the deep influence of phrase structure–based grammars such as Generalized Phrase Structure Grammar (Gazdar et al. 1985), Lexical Functional Grammar (LFG; Bresnan 1982), and Categorial Unification Grammar (Uszkoreit 1986). HPSG is particularly characterized by its simplification of syntax through giving a great weight on lexicon, incorporation of Situation Semantics (Barwise and Perry 1983) as a semantic theory, and adoption of the Typed Unification Grammar (TUG) formalism (Aït–Kaci 1984) that combines the unification–based approach and type inference.

Following the TUG formalism, all linguistic knowledge, both grammar rules and lexicon, are represented as TYPES, which are defined in a lattice hierarchy based on subsumption relationships. On the basis of this hierarchical knowledge-base a type is rewritten as a subtype, while unification between the feature structures attached to the types is tested at the same time.

In HPSG syntax, the PRINCIPLES, which constrain the syntactic and semantic relationships between the mother and daughters of a local tree, perform leading funcions. Among them, the Subcategorization Principle specifies the relationship between the head daughter and its complements. The Nonlocal Feature Principle, analogous to the Foot Feature Principle of GPSG (Gazdar et al. 1985), takes care of unbounded dependency. These and other syntactic principles cooperate with the Semantics Principle that constructs the semantic information of the mother from that of the daughters. The Semantics Principle employed in this paper diverges from the original one in that it constructs Discourse

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Representation Structures (DRS's), semantic representations based on Discourse Representation Theory (DRT; Kamp and Reyle 1993), within its semantic component (Bos et al. 1994, Yoshimoto 1996).

The Autosegmental Metrical Theory (AMT) is a phonological approach to intonation that has been developed by Pierrehumbert (1980) and applied to Japanese by Pierrehumbert and Beckman (1988). The goal of the AMT is to capture contours by means of a sequence of distinct, underspecified tones (e.g. H for a high tone, L for a low tone, and H% and L% for high and low boundary tones) so that continuous phonetic phenomena may be accounted for. The ATM approach is particularly suitable for defining interfaces between syntax and phonology by means of the constraint–based framework.

3. PROSODY IN JAPANESE

In this section I illustrate distinctive characteristics in Japanese prosody and propose a linguistic model that can produce appropriate intonational contour for Japanese sentences, and by doing so pave the way for the following discussion on foci.

3.1 Overview

In organizing Japanese prosody patterns, some essential part is played by a tonal domain that I will call the ACCENTUAL PHRASE (AP). The AP is lexically introduced and corresponds roughly to the unit that has been traditionally referred to as the BUNSETSU. It contributes partly to disambiguating lexical meanings and partly to delimiting syntactic phrases. Each AP exhibits either a tone pattern with a sharp fall from high pitch or a pattern without such a fall. The first is phonologically interpreted as ACCENTED and the second as UNACCENTED. In an accented AP, the ACCENTED MORA is defined to be the mora immediately before the sharp fall. An AP has at most one accented mora.

Although the AP is thus the fundamental domain in which accentedness is fixed, the real sentence pitch contour, which can be safely modeled by the fundamental frequency (f_0) contour (Pierrehumbert and Beckman 1988), depends on more complex factors. The morae following an accented mora receive a pitch value lower than those following an unaccented mora for a certain syntactic domain (CATATHESIS; Poser 1984). Furthermore, in a double adjunction phrase, the second adjunct is boosted if it immediately forms a constituent with the head rather than with the first adjunct (METRICAL BOOST; Kubozono 1987). Likewise, focus, the main topic in this paper, affects the pitch contour. In addition, there is another physiological source of downtrend called DECLINATION that occurs over an utterance. Lastly, intonation impinges on the overall prosodic pattern of the sentence. Of the various patterns available in Japanese, the constant lowering in the latter part of utterance and the abrupt rise near the utterance end are assumed in this paper to be typical intonations for a declarative and interrogative sentence, respectively.

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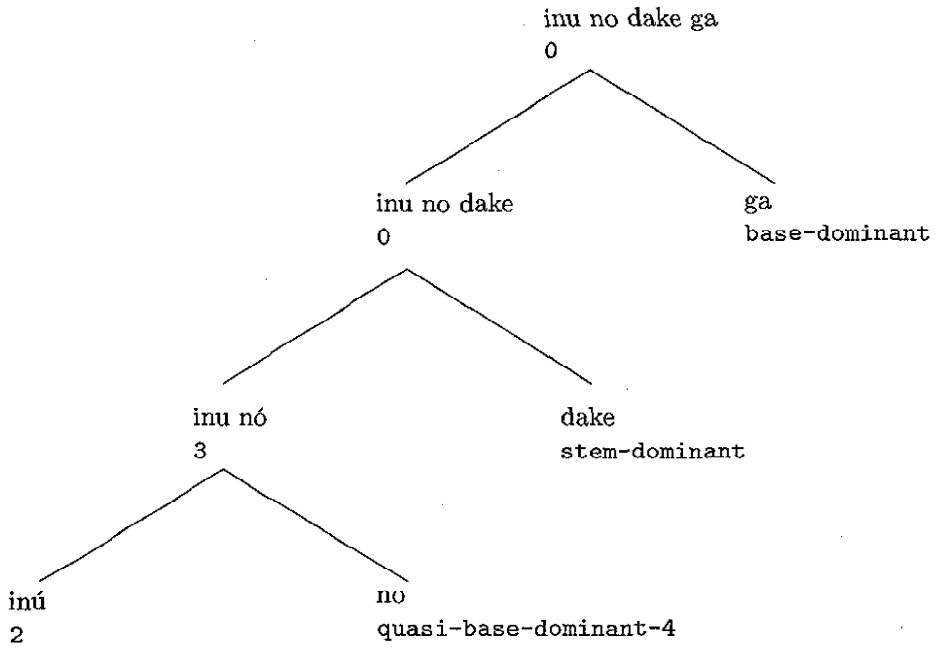

Figure 1: PAU Formation

3.2 Potential Accentual Unit

The 'bunsetsu' in traditional grammar is a fuzzy notion that is defined mainly on the basis of syntax. In this paper, what has been referred to by this term is redefined purely syntactically and called a POTENTIAL ACCENTUAL UNIT (PAU). By contrast, the ACCENTUAL PHRASE (AP), constituted of one or more PAU's, is defined phonologically by delimitative tonal markings at the beginning and end of the phrase.

A PAU is formed by recursively attaching a FUNCTION WORD, i.e. a postposition, clitic complementizer, or verbal or adjectival conjugational ending, to a FULL WORD, i.e. a noun, verbal or adjectival stem, or adverb. The accent information of a PAU is obtained compositionally from lexical sources: the right–hand function word plays the role of a functor whose argument is the left–hand sequence consisting of a full word and (possibly null) function words. Figure 1 illustrates how the accent–specifying functions triggered by the postpositions *no* (GENITIVE–NOMINALIZER), *dake* (only), and *ga* (NOMINATIVE) are recursively applied to form the AP information of the phrase *inu no dake ga* (only what belongs to the dog–NOMINATIVE). For example, the postposition *no* corresponds to the type `quasi-base-dominant-4`, which maps a sequence with an accent on the last mora into a sequence with an accent on *no*.

Throughout this paper, the accent information of a PAU and an AP is indicated by an integer value of the attribute path `PHONOLOGY|ACCENT`. The value `0` means that the PAU or AP is unaccented. A natural number value n ($n \geq 1$) indicates that the PAU/AP is accented and that the accent (marked by ´ in the examples) falls on the nth mora

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in the PAU/AP. In Figure 1, the noun *inú* (dog), whose PHONOLOGY|ACCENT value is 2 when pronounced independently, is mapped by the function word *no* to *inu nó* with a PHONOLOGY|ACCENT value being 3.

The accent information in a PAU is obtained by evaluating a type potential-accentual-unit, whose accentual information is taken over by an accentual-phrase when it is formed by concatenating PAU's. At the same time, the pitch value of the AP is measured in relation to the effects caused by metrical boost and focusing, as will be discussed in the following sections. The type potential-accentual-unit calculates the accent information by means of accent calculation rules such as base-dominant and quasi-base-dominant-4 on the basis of the information in the full word and function word. The same set of accent calculation rules is used, irrespective of whether the function word is a postposition or a clitic complementizer, and accordingly, the two words are concatenated at the syntactic level, or the function word is a conjugational ending that is suffixed to the stem in morphology. In this way, the modularized rules are efficiently employed in acquiring accent information.

In the following part of this section I will discuss how the prosody information in an AP is drawn from that in the PAU's. Before doing so, however, it must be examined how the AP formation is constrained by syntax.

3.3 Adjunction Branching and Metrical Boost

Kubozono (1987) has shown that when two adnominal adjuncts modify a noun, a second adjunct directly modifying the noun has a higher peak than a second adjunct modified by the first adjunct. In examples (1a) and (1b),

(1) a. [aói [**óokina** méron]]
green big melon
'a green big melon'

b. [[aói [**rémon**] no niói]]
green lemon GEN smell
'the smell of a green lemon'

the peak of the AP *óokina* in (1a) is higher than that of *rémon* in (1b). Choi, Satō and Min (1995) also observe a similar difference in peaks of adverbial adjuncts modifying a verb.

Whitelock (1991) tries to obtain the above pitch value by multiplying the default value by b (> 1), a constant indicating the relative pitch of the phrase to which this 'metrical boost' is applied. If we adopt Whitelock's solution in our framework, we need a type specification (say, boost-rule [ ]) that works in conjunction with the Adjunction Principle, i.e. an HPSG principle that conjoins an adjunct and its head. The type boost-rule[ ] will assign the same boost value to a terminal lexical-sign[ ] head daughter as that of the mother,

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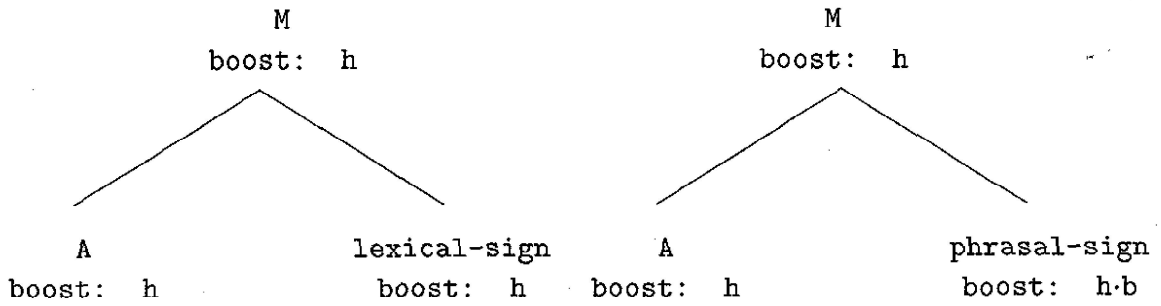

Figure 2: Metrical Boost Specification after Whitelock

but assign the multiplication of the mother's `boost` value by b to a $_{\texttt{phrasal-sign}}[\ ]$ head dominating other adjuncts (see Figure 2).

However, this predicts a wrong boosted value for a phrase with three adjuncts. As Kubozono (1987) has revealed,

(2) a. $[A_1\ [\mathbf{A_2}\ [A_3\ H]]]$

b. $[[A_1\ [\mathbf{A_2}\ A_3]]\ H]$

c. $[A_1\ [[\mathbf{A_2}\ A_3]\ H]]$

in (2a)–(2c) in which the second adjunct A_2 is metrically boosted, A_2 in (2c) receives a much higher pitch value than (2a) and(2b), while (2a) and (2b) have almost the same value. This data is contradictory to Whitelock's proposal, which assigns the same value $h{\cdot}b$ (where h is the pitch of the tree root) to all of the cases.

Alternatively, I propose a function `get-boost(x)` that calculates the `boost` value of an AP from the boost constant and the RELATIVE DEPTH of the word. The `relative-depth` value is defined on the basis of the `depth` value of each word, the value derived by recursively adding one to the mother's `depth` value each time the Adjunction Principle is applied. As illustrated in Figure 3 (the PAU's are abbreviated for simplicity), daughters of the same mother share the same `depth` value that is larger than that of the mother by one. The `depth` value is passed to an AP when the AP is formed, by way of the feature in the full word. The `relative-depth` value r_n of an AP A_n with its `depth` value d_n is computed when an IP is formed, from the `relative-depth` value r_{n-1} and the `depth` value d_{n-1} of the preceding AP A_{n-1} by the following formula:

(3) $r_n = r_{n-1} + (d_n - d_{n-1})$

The `relative-depth` value of the initial AP is `0`. It is left an open question how `get-boost(x)` should be defined, for it must also be applied recursively to cases with more than four adjuncts and at present no data is available to accomodate such constructions. The examples taken in the following are limited to cases where the `relative-depth` value is `1` and the `boost` value is b, the same as the constant.

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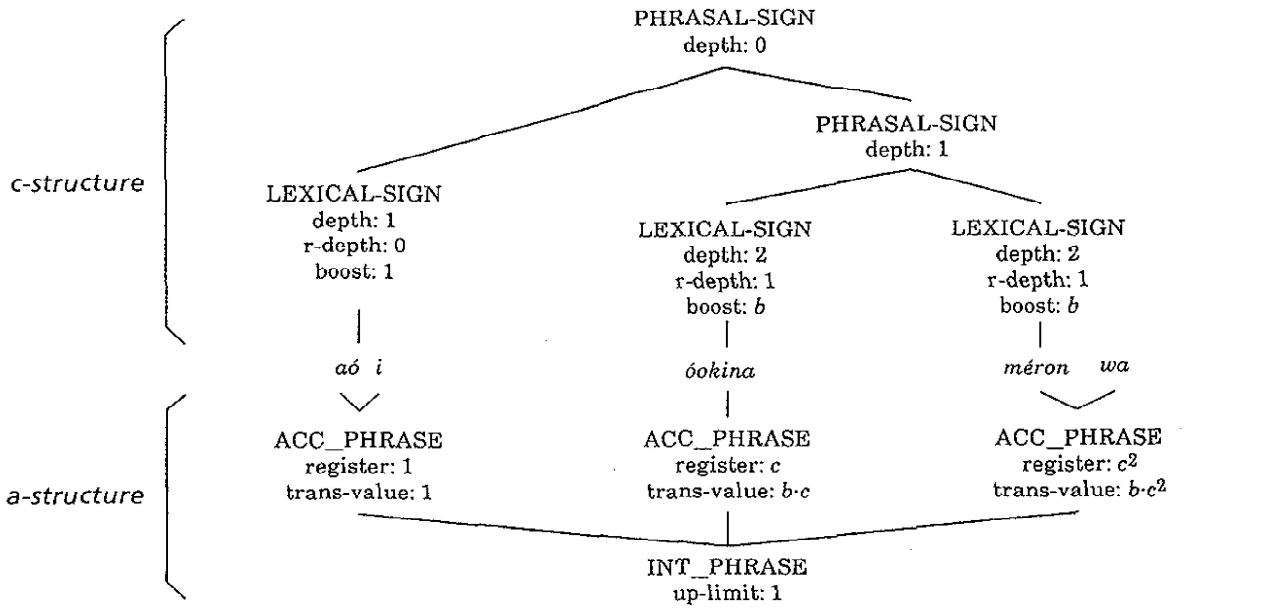
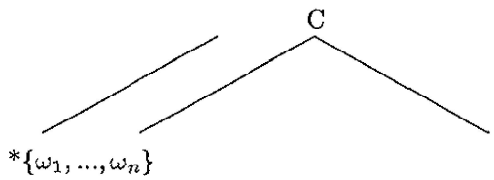


Figure 3: Relative-Depth and Metrical Boost

The 'metrical boost' is also of importance in discussing syntax: efficiency in syntax requires two independent syntactic modules, one representing a semantics–based constituent structure and called C–STRUCTURE in Figure 3, and the other corresponding to AP's and IP's and referred to as A–STRUCTURE in the figure, which interact with each other to compose appropriate information on the pitch of AP's.

The 'metrical boost' spelled out above overlaps with a more general constraint on relationships between prosody and syntax. Based on her analysis of Korean, a language that shares with Japanese many important characteristics in AP's, Jun (1996, p. 186) proposes a syntactic constraint on the accentual phrasing of the language:

(4) An Accentual Phrase cannot include a prosodic word 'ω' to the preceding word(s), if 'ω' is the last prosodic word, ω_n of the Accentual Phrase and the left element of the branching constituent C.



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Our analysis of Japanese data attests to the same negative constraint on accentual phrasing. This requires a restriction on the PAU so that it does not appear both at the end of an AP and at the beginning of a phrasal sign at the same time. From this perspective, the 'metrical boost' can be paraphrased as a prohibition against an AP composed both of the second adjunct directly modifying the noun and of the preceding adjunct on one hand, and emphasis of this boundary between the two AP's, on the other. In fact, Choi, Satō and Min (1995) confirm the AP segmentation provided below, where { } indicates a possible accentual phrasing:

(5) a. [aói [**óokina** méron]]
green big melon
{ } { }
'a green big melon'

b. [[aói [**rémon**] no niói]]
green lemon GEN smell
{ } { }
{ }
'the smell of a green lemon'

3.4 Accentual Phrase Formation

Now we are ready to explore how to construct an AP out of PAU's. Jun (1996, p. 187) proposes the following rules for Korean, which apply also to Japanese according to our experiments:

(6) The Accentual Phrasing Rules

(a) Every prosodic word may be an Accentual Phrase.

(b) A focused word must be the left–most word in an Accentual Phrase.

(c) An Accentual Phrase can include any number of prosodic words as long as:

i. the last prosodic word is not the left element of a branching constituent.

ii. all the prosodic words are not focused.

These rules, called 'formal rules' by Jun, are in fact not very formal in that they do not involve any specific algorithm to decide what is an appropriate AP and what is not. However, they at least furnish a clue to set up the algorithm. In setting up the algorithm, we must take into account various factors such as speech rate, the number of syllables within the phrase, focus, the semantic richness of the word, and the structure of a compound, as Jun (1996) did in dealing with her Korean data. Since we are still in the initial stages of our data analysis and experiments, I will just present a simple algorithm to approximate AP's in Japanese:

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(7) AP Formation Rule

(i) A PAU placed at the beginning of a phrasal sign cannot be the last PAU within an AP.

(ii) In a focused AP, the phonological effect of focusing manifests itself on the initial PAU, followed by non–boosted PAU's.

(iii) As long as an AP satisfies the conditions (i) and (ii), the following constructions each constitute one AP:

(a) Determiner + Noun e.g. *kono hito* (this person)

(b) Adjectival Phrase + Noun e.g. *kawaii kodomo* (a pretty child)

(c) NP + Genitive PP + Noun e.g. *sensei no ie* (the teacher's house)

(d) Adverbial Phrase + Verb e.g. *jōzuni dekiru* (can do well)

(e) NP + Verb e.g. *bin wo akeru* (open a bottle)

(f) Adverbial Phrase + Adjective e.g. *totemo shizukada* (very quiet)

(g) Adverbial Phrase + Adverbial Phrase e.g. *hijōni kōmyōni* (very skillfully)

(iv) The following constructions are split into two AP's (the boundary is indicated by '/'):

(a) Postpositional Phrase/Noun Phrase + Verb e.g. *ie de/terebi wo mi–ta* (watched television at home)

(b) Adverbial Phrase/Noun Phrase + Verb e.g. *sassato/shigoto wo katazukeru* (finish the work quickly)

(c) Noun Phrase/Adverbial Phrase + Verb e.g. *shigoto wo/sassato katazukeru* (finish the work quickly)

(d) Topic Noun Phrase/Verbal Phrase e.g. *aoi meron wa/kore desu* (The green melon is this)

(e) Sentential Adverbial Phrase/Noun Phrase + Verbal Phrase e.g. *komatta koto ni/kasa ga nai* (unfortunately, I don't have an umbrella)

(i) in rule (7) is specified using HPSG in the following way:

(8) a. $\texttt{comp-dtr}[\ ] \Longrightarrow \neg_{\texttt{pau}}[\ \texttt{PHON|ACC-PROPERTY|AP-TAIL} +\ ]$

b. $\texttt{adj-dtr}[\ ] \Longrightarrow \neg_{\texttt{pau}}[\ \texttt{PHON|ACC-PROPERTY|AP-TAIL} +\ ]$

$\texttt{comp-dtr}[\ ]$ and $\texttt{adj-dtr}[\ ]$ are each values of the attribute paths DAUGHTERS|COMPLEMENT-DAUGHTER and DAUGHTERS|ADJUNCT-DAUGHTER. Since throughout this paper syntactic trees are limited to be binary, the initial PAU in a phrasal sign is always a non–head, i.e. a complement or an adjunct.

The type inference rule corresponding to (ii) is of the form below:

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(9) $_{\texttt{pau}}[\ ] \Longrightarrow$

$$\texttt{focused-pau}\left[\ \texttt{PHON|ACC-PROPERTY}\ \left[\begin{array}{ll}\texttt{AP-INITIAL} & +\\ \texttt{FOCUSED} & +\end{array}\right]\ \right]$$

$$\vee\ _{\texttt{nonfocused-pau}}[\ \texttt{PHON|ACC-PROPERTY|FOCUSED}\ -\ ]$$

This rule says that a PAU is either focused and AP–initial or unfocused and unspecified in terms of its place in the AP. The values of AP-TAIL and AP-INITIAL are used to check its location in the AP when the PAU is added to an AP.

3.5 Intonational Phrase

The INTONATIONAL PHRASE (IP), the phonological domain larger than the AP, is motivated by catathesis, i.e. suppression of pitch after the accented mora (Poser 1984). Little data is yet available about how compound and complex sentences are segmented into IP's. This paper, concentrating on the prosody of simple sentences, assumes that the IP is defined syntactically on the following criteria:

(i) An untopicalized sentence constitutes an IP.

(ii) A topic and the rest of the sentence each correspond to an IP.

The phonological information of an IP is built by a type $_{\texttt{int-ph}}[\ ]$ as the value of PHONOLOGY|ACC-PHS by picking up the phonological value of each AP, appending it to a list recursively, and finally inserting boundary tones at the beginning and end of the IP.

Poser (1984) has shown that to the right of an accent, the pitch range over the IP is lowered. When an accented mora is met repeatedly within the same IP, a descending staircase results. Following Pierrehumbert and Beckman's (1988) formulation, I model catathesis by multiplying the high–tone line (the upper limit), on which particular tones depend, by the constant c (< 1), and this can be iterated within the same IP. A type $\texttt{catathesis-rule}[\ ]$ performs this task in conjunction with the type $_{\texttt{int-ph}}[\ ]$.

When the last AP in the list being made is unaccented, the attribute REGISTER, which represents the high–tone line of the AP, of the AP to be appended to the list is set to the same value as that of the first. When the first AP is accented and has accordingly a natural number value for ACCENT, the REGISTER value of the subsequent AP is obtained by multiplying the REGISTER value of the former AP by the catathesis constant c.

The REGISTER value of the first AP in the IP is set to 1, following Pierrehumbert and Beckman's (1988) TRANSFORMED VALUE for convenience. The real hertz pitch p is measured from the transformed value t, the high–tone line hertz value h, and the reference line (neutral f_0) value r according to the following formula:

(10) $p = t \cdot (h - r) + r$

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In my grammar specification, this value is obtained by the function `get-pitch(x,y)`.

3.6 Integration of Prosody Information

Below I give a rule stipulating the pitch value of an AP based on the information on metrical boost, focus, and catathesis. The validity of the rule depends on appropriate segmentation into AP's sketched in (7), (8a)–(8b), and (9). The function `get-pitch(x,y)` measures the pitch value based on the boolean value (i.e. + or −) indicating whether the AP is focused, and the transformed value, which is in turn gained by multiplying the register value and the boost value.

(11)

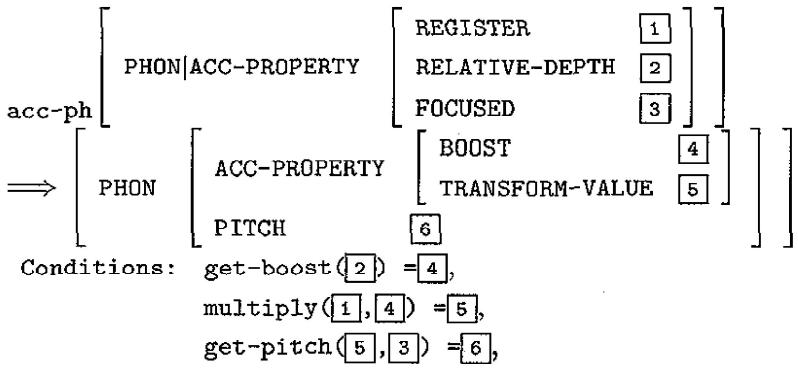

Figure 4 depicts how the phonological information in the lexicon, AP's, and IP's are integrated to form that of utterance (12).

(12) Aoi meron wa kore desu.
green melon TOP this COP
'The green melon is this.'

4. FOCUS IN JAPANESE

This section addresses the syntactic and semantic issues of focus in Japanese.

4.1 Minamian Hierarchy and Potential Focus Scope

It has often been discussed that the interpretation of focus is affected by Minami's (1974) four-layered hierarchical clause structure whose analogue is found in Foley and Van Valin's (1984) Role and Reference Grammar. In this paper, I will adopt Takubo's (1987) term POTENTIAL FOCUS SCOPE (PFS) to refer to that part of sentence which is syntactically known to be the place of focus. A real focus, if any, falls on the constituent that constitutes the whole or a part of this scope, depending on the semantic, discourse grammatical, and pragmatic factors.

The Level A subordinate clause, the subordinate clause composed of the innermost clause in Minami's hierarchy, is included in the PFS, which is indicated by angle brackets.

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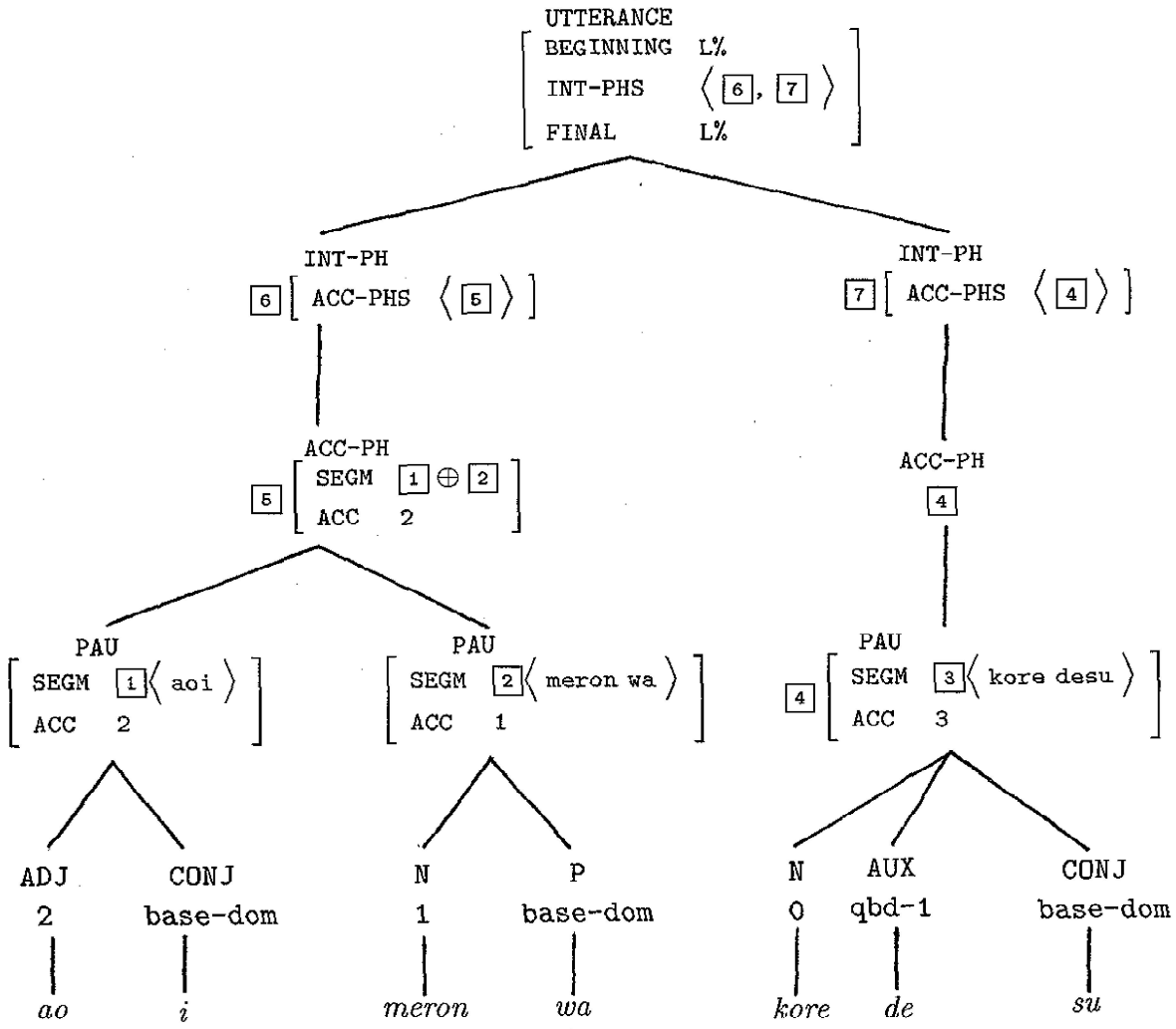

Figure 4: Prosody Information for Sentence (12)

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(13) a. ⟨Tarō ga [terebi wo mi]$_A$ nagara shimbun wo yomu⟩.
NAME NOM TV ACC see SIML newspaper ACC read

'Tarō reads a newspaper while watching television.'

b. ⟨Tarō ga [terebi wo mi]$_A$ nagara shimbun wo yoma–⟩ nai.
NAME NOM TV ACC see SIML newspaper ACC read NEG

'Tarō does not read the newspaper while watching television.'

c. ⟨Tarō ga [terebi wo mi]$_A$ nagara shimbun wo yomi–masu–⟩
NAME NOM TV ACC see SIML newspaper ACC read POLT

ka?
INTR

'Does Tarō read the newspaper while watching television?'

In (13a), the whole sentence is within the PFS. The real focus may be the whole sentence or part of it, e.g. *terebi wo mi* (watch television). In that case, it is already known that Tarō reads a newspaper while doing something, and the speaker intends to convey what it is. Alternatively, it is equally possible that the focus is *terebi wo* (television–ACC) in a situation where Tarō's reading the newspaper and watching something at the same time is mutually known and the object of the watching is at issue. Likewise, in (13b) and (13c), a focus of negation or question can fall within but not out of the PFS.

The Level B subordinate clause, consisting of the Level A clause and some more surrounding constituents, is usually excluded from the PFS.

(14) a. [Haruko ga sotsugyō–shi– ta]$_B$ node ⟨ϕ issho–ni
NAME NOM graduate PAST CASL (SBJ) together

ryokō shi– ta⟩.
travel PAST

'Because Haruko had graduated, I made a trip with her.'

b. [Tarō ga uwagi wo nugu]$_B$ to ⟨ϕ hangā ni kake–⟩
NAME NOM jacket ACC undress SUCC (SBJ) hanger LOC hang

nakat– ta.
NEG PAST

'Tarō took off his jacket and someone did not hang it on a hanger.'

c. [Tarō ga uwagi wo nugu]$_B$ to ⟨ϕ hangā ni kake–
NAME NOM jacket ACC undress SUCC (SBJ) hanger LOC hang

mashi– ta–⟩ ka?
POLT PAST INTR

'After Tarō had taken off his jacket, did anyone hang it on a hanger?'

However, if the matrix predicate is followed by *no da* or *wake da*, sentence endings each made up of a complementizer and a copula and typically used when the speaker tries to add more information to a subject of conversation already shared with the hearer, the Level B subordinate clause is included in the PFS.

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(15) a. ⟨[Haruko ga sotsugyō–shi– ta]$_B$ node ϕ issho–ni
NAME NOM graduate PAST CASL (SBJ) together
ryokō–shi– ta⟩ no desu.
travel PAST EXPL–POLT
'It is because Haruko had graduated that I made a trip with her.'

b. ⟨[Tarō ga uwagi wo nugu]$_B$ to ϕ hangā ni kake–
NAME NOM jacket ACC undress SUCC (SBJ) hanger LOC hang
ta⟩ no de wa nai.
PAST EXPL CONT NEG
'It is not the case that Tarō took off his jacket and someone hung it on a hanger.'

c. ⟨[Tarō ga uwagi wo nugu]$_B$ to ϕ hangā ni kake–
NAME NOM jacket ACC undress SUCC (SBJ) hanger LOC hang
ta⟩ no desu– ka?
PAST EXPL–POLT INTR
'Is it that Tarō took off his jacket and someone hung it on a hanger?'

(15a) can be an answer to a question about the reason of the speaker's having made a trip with Haruko but (14a) cannot, inasmuch as the causal clause marked by *node* is included in the PFS in (15a), but not in (14a). Similarly, the successive clause headed by *to* can be in the content of negation and question in (15b) and (15c), but outside the scope of negation or question in (14b) and (14c).

The Level C subordinate clause, containing more peripheral constituents, always lies out of the scope.

(16) a. [Haruko wa Supein e iku]$_C$ ga ⟨Akiko wa Itaria e
NAME TOP Spain GOAL go ADVS NAME TOP Italy GOAL
ika–⟩ nai.
go NEG
'Haruko goes to Spain, but Akiko doesn't go to Italy.'

b. [Haruko wa Supein e iku]$_C$ ga ⟨Akiko wa Itaria e
NAME TOP Spain GOAL go ADVS NAME TOP Italy goal
iki– masu–⟩ ka?
go POLT INTR
'Haruko goes to Spain, you know. Does Akiko go to Italy, too?'

4.2 Rules

Next, let us turn to how rules should be posited for focus in the different Minamian levels. As has been explained in the previous section, the Level A subordinate clause is included in the PFS, but the Level B or C subordinate clauses are not.

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In this paper, the focus is considered as a kind of unbounded dependency, because theoretically there is no telling in advance how deep the focused constituent is embedded. For simplicity, the focused constituent is limited to a full word. A focused full word contains information on its own phonological and semantic value under the attribute path NONLOCAL|INHERITED. Its value is limited to a unit set.

(17) $$\texttt{full-word}\,[\ ] \Longrightarrow \texttt{nonfocused-full-word}\,[\ ]$$
$$\vee$$
$$\texttt{focused-full-word}\left[\begin{array}{ll} \texttt{PHON} & \boxed{1} \\ \texttt{SEM} & \boxed{2} \\ \texttt{NONLOCAL|INHERIT|FOCUS} & \left\{\left[\begin{array}{ll}\texttt{PHON} & \boxed{1}\\ \texttt{SEM} & \boxed{2}\end{array}\right]\right\} \end{array}\right]$$

The Nonlocal Feature Principle transmits the FOCUS information to the Level B matrix clause through the Level A clause. Originally, this principle collects the INHERITED value on the daughters and tries to match them with the TO-BIND value on the head daughter. Within the Level A clause, information on FOCUS can come both from the predicate and from the adjunct. Therefore, the whole Level A clause becomes the PFS of the sentence. The value of NONLOCAL|INHERITED|FOCUS is a unit set and the TO-BIND feature is directly introduced by the type $\texttt{focused-b-predicate}\,[\ ]$ corresponding to a focused Level B matrix predicate, resulting in evacuation of the FOCUS value throughout the higher level clauses. At the same time, the single element of the set value of FOCUS is unified with the value of the attribute path PRAG|PRAGFOCUS.

(18) $$\texttt{focused-b-pred}\,[\ ] \Longrightarrow$$
$$\left[\begin{array}{ll} \texttt{NONLOCAL} & \left[\begin{array}{ll}\texttt{INHERIT|FOCUS} & \{\boxed{1}\left[\ \texttt{SEM|DRS}\ \ \boxed{2}\ \right]\} \\ \texttt{TO-BIND|FOCUS} & \{\boxed{1}\}\end{array}\right] \\ \texttt{PRAG|PRAGFOCUS} & \boxed{2} \end{array}\right]$$

Since on $\texttt{b-clause}\,[\ ]$, the mother of the $\texttt{focused-b-predicate}\,[\ ]$, the value of NONLOCAL|INHERITED|FOCUS is bound off by the Nonlocal Feature Principle, FOCUS information within a Level B adjunct is excluded from higher levels.

The semantic and pragmatic information of sentence (14a), on the assumption that a focus is placed on the adverb *issho-ni* (together), is presented below. For details of the temporal information in (19), see Yoshimoto (1996).

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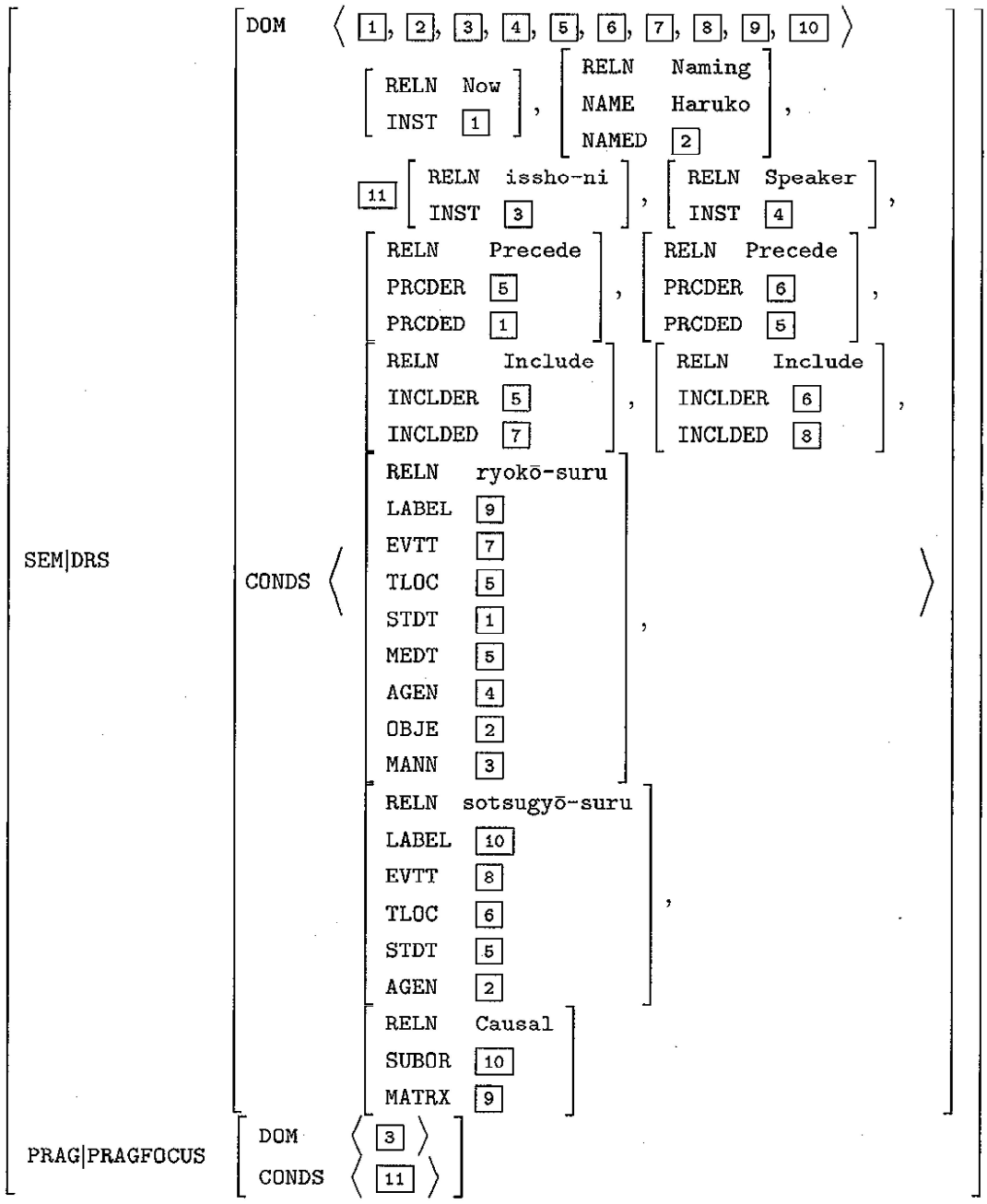
(19)



Information on constituents outside the PFS is excluded from the PRAG|PRAGFOCUS value by the stipulation that the focus information only derives from that of the Level A matrix clause.

The essential part of the phonological information corresponding to sentence (14a) with a focus on *issho-ni* is the following set including two pieces of AP information:

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(20)
$$\left\langle \begin{array}{l} \text{acc-ph} \left[\begin{array}{ll} \text{SEGM} & \langle\ \text{Haruko ga sotsugyō-shi ta node}\ \rangle \\ \text{FOCUSED} & - \end{array} \right], \\ \text{acc-ph} \left[\begin{array}{ll} \text{SEGM} & \langle\ \text{issho-ni ryokō-shi ta}\ \rangle \\ \text{FOCUSED} & + \end{array} \right] \end{array} \right\rangle$$

The pitch of the second focused AP is measured by the specification in (11). In this way, the phonology, syntax, semantics, and pragmatics of focus is linked on the basis of the common TUG framework.

The last task we must face is to account for the behavior of the sentence endings *no da* and *wake da* which make the sentence include the Level B subordinate clause in its PFS (see example (15a)–(15c)). For this purpose let us assume that these auxiliary verbs are immensely powerful in terms of focus; they subcategorize for a type `marked-b-clause`[ ], which in turn has a `marked-focused-b-predicate`[ ] as its head daughter. To this type the inference rule (18) is not applied. In consequence, the value of NONLOCAL|TO-BIND|FOCUS is not introduced at this level: it is introduced at a higher level when *no da* or *wake da* is concatenated to a Level B clause and only then the value of NONLOCAL|INHERITED| FOCUS is popped off.

These rules produce the following feature structure corresponding to sentence (15a) with a focus on *sotsugyō–shi–ta* (graduate–PAST) that is outside the PFS of (14a).

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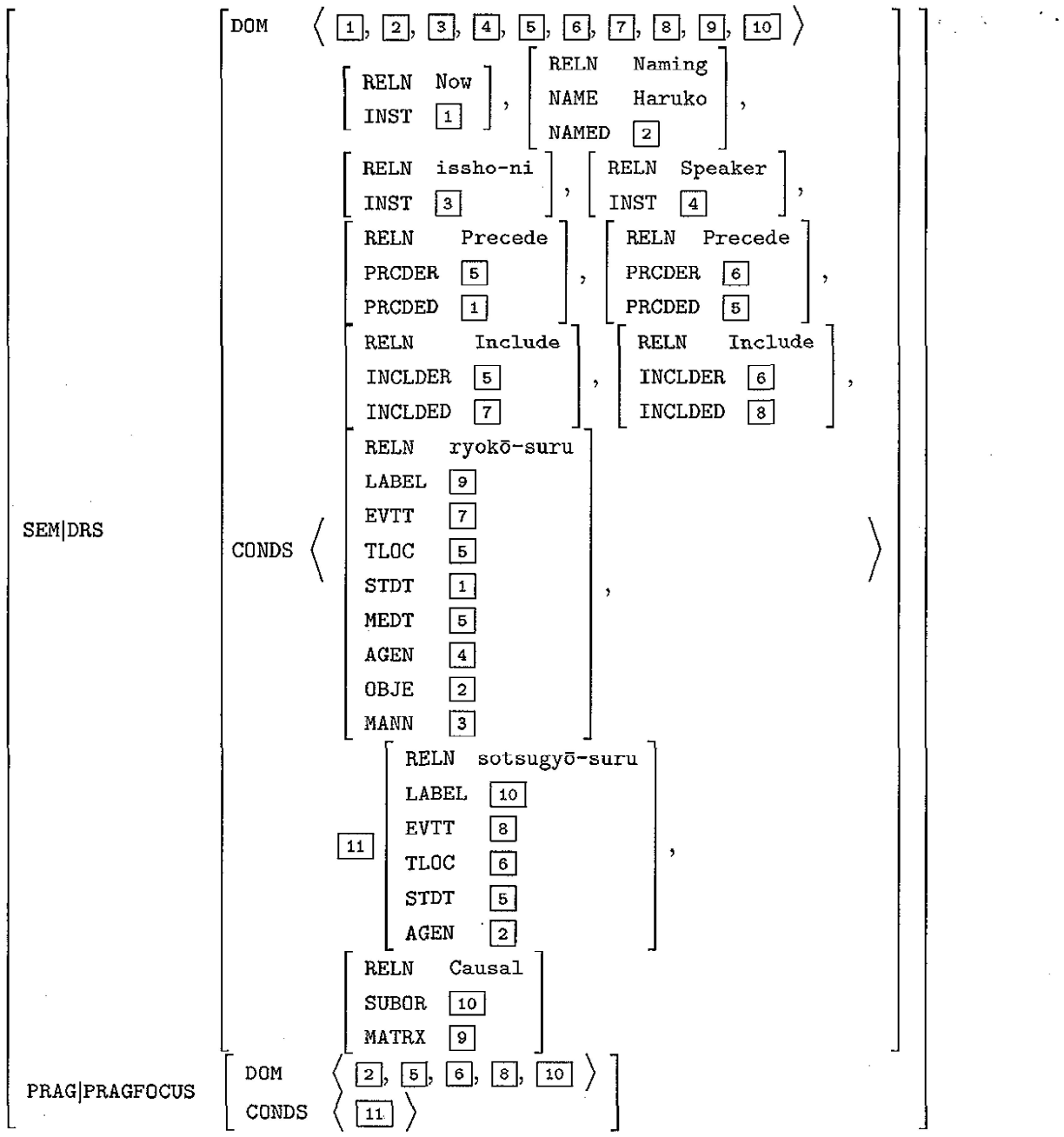
(21)



5. FOCUS IN ENGLISH

English has various means to express a focus. The two most important of them are what I call UNMARKED FOCUS and MARKED FOCUS.

5.1 Unmarked Focus

In an unmarked focus sentence, or in what Greenbaum and Quirk (1990) refer to as an END–FOCUS sentence, the focus is placed at the end of the sentence (the phonetically stressed syllable is indicated by SMALL CAPITALS).

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(22) We are going to the RACes.

The discourse meaning meant by this prosody pattern is that there is a new piece of information and it must be looked for within the VP. In other words, the PFS, introduced in the last section, falls on the VP of the sentence. Accordingly, the new information of the sentence is *to the races*, *going to the races*, or *are going to the races*. I will restrict the rules so that new information is only carried by lexical signs, though this may be too much of a simplification. An inference rule similar to (17) is in charge of this:

(23)
$$\texttt{meaningful-lsign}\left[\ \right] \Longrightarrow \texttt{nonfocused-meaningful-lsign}\left[\ \right]$$
$$\vee$$
$$\texttt{focused-meaningful-lsign}\left[\begin{array}{ll}\texttt{PHON} & \boxed{1}\\ \texttt{SEM} & \boxed{2}\\ \texttt{NONLOCAL|INHERIT|FOCUS} & \left\{\left[\begin{array}{ll}\texttt{PHON} & \boxed{1}\\ \texttt{SEM} & \boxed{2}\end{array}\right]\right\}\end{array}\right]$$

The rule is only applied to a lexical sign with a semantic content: in the above example, *races*, *going*, and *are*. The phonological information in (23) is trivial here, since the pitch always falls on the last word, as specified in the following rule to be applied to a VP:

(24)
$$\texttt{end-focused-vp}\left[\ \right] \Longrightarrow \left[\begin{array}{ll}\texttt{PHON|LAST-WORD|STRESSED} & +\\ \texttt{NONLOCAL} & \left[\begin{array}{ll}\texttt{INHERIT|FOCUS} & \left\{\boxed{1}\left[\texttt{SEM|DRS}\ \boxed{2}\right]\right\}\\ \texttt{TO-BIND|FOCUS} & \left\{\boxed{2}\right\}\end{array}\right]\\ \texttt{PRAG|PRAGFOCUS} & \boxed{1}\end{array}\right]$$

Similar to (18), (24) also binds off the FOCUS value that has been percolated up the tree by means of the Nonlocal Feature Principle, as a result making the VP the PFS of the sentence.

These rules produce DRS's that are ambiguous in terms of the PRAGFOCUS value, because no particular stress on the focused constituent can supply a clue to resolve the ambiguity. Accordingly, the feature structure corresponding to example (22)

(25)
$$\left[\texttt{SEM|DRS}\left[\begin{array}{ll}\texttt{DOM} & \left\langle \boxed{1}, \boxed{2}, \boxed{3}, \boxed{4}, \boxed{5}, \boxed{6}\right\rangle\\ & \left[\begin{array}{ll}\texttt{RELN} & \texttt{Now}\\ \texttt{INST} & \boxed{1}\end{array}\right], \left[\begin{array}{ll}\texttt{RELN} & \texttt{We}\\ \texttt{INST} & \boxed{2}\end{array}\right],\\ \texttt{CONDS} & \left\langle \boxed{7}\left[\begin{array}{ll}\texttt{RELN} & \texttt{race}\\ \texttt{INST} & \boxed{3}\end{array}\right], \boxed{8}\left[\begin{array}{ll}\texttt{RELN} & \texttt{Precede}\\ \texttt{PRCDER} & \boxed{1}\\ \texttt{PRCDED} & \boxed{6}\end{array}\right],\right.\\ & \left.\left[\begin{array}{ll}\texttt{RELN} & \texttt{Include}\\ \texttt{INCLDER} & \boxed{6}\\ \texttt{INCLDED} & \boxed{5}\end{array}\right], \boxed{9}\left[\begin{array}{ll}\texttt{RELN} & \texttt{go}\\ \texttt{EVTT} & \boxed{5}\\ \texttt{TLOC} & \boxed{6}\\ \texttt{AGEN} & \boxed{2}\\ \texttt{GOAL} & \boxed{3}\end{array}\right]\right\rangle\end{array}\right]\right]$$

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has as its PRAG|PRAGFOCUS value [7], [8], or [9]. Disambiguation must be made in relation to the discourse and pragmatic information.

5.2 Marked Focus

The marked focus sentence in English is a sentence with a focus on a constituent lying at a place other than the end of the sentence.

(26) *I am painting my* LIV*ing room blue.*

Rule (23) is applied to make the stressed word *LIVing room* the focus of the whole sentence, together with the Nonlocal Feature Principle. This type of sentence is distinct from the unmarked focus sentence in that the whole sentence becomes the PFS, which requires the following rule specifying where the transmitted FOCUS value is bound off:

(27)
$$\texttt{marked-focused-sentence}\begin{bmatrix}\end{bmatrix} \Longrightarrow \begin{bmatrix} \texttt{PHON|LAST-WORD|STRESSED} & - \\ \texttt{NONLOCAL} & \begin{bmatrix} \texttt{INHERIT|FOCUS} & \{\boxed{1}\begin{bmatrix}\texttt{PHON|STRESSED} & +\\ \texttt{SEM|DRS} & \boxed{2}\end{bmatrix}\} \\ \texttt{TO-BIND|FOCUS} & \{\boxed{1}\} \end{bmatrix} \\ \texttt{PRAG|PRAGFOCUS} & \boxed{2} \end{bmatrix}$$

Note that in (27), the value of FOCUS is limited to a word with a phonological stress. By contrast, in (24) no such constraint is imposed, consequently allowing a focused constituent to be either stressed or unstressed.

6. PARAMETRIZED APPROACH

The rules that have been posited for focus processing in sections 4 and 5 are of the same or highly similar form. The rules given as (i), (iii), (v), and (vii) in Table 1 can all be reduced to the type inference rule (28):

Table 1: Focus–Related Rules in Japanese and English

Japanese	
non–extended predicate (i) focused-full-word[ ] (ii) focused-b-pred[ ]	extended predicate (iii) focused-full-word[ ] (iv) extended-pred-clause[ ]
English	
unmarked–focus sentence (v) focused-meaningful-lsign[ ] (vi) end-focused-vp[ ]	marked–focus sentence (vii) focused-meaningful-lsign[ ] (viii) marked-focused-sentence[ ]

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(28) introduce-focus[ ] ⟹ (focused-full-word[ ] ∨ focused-meaningful-lsign[ ])

$$\wedge \quad \text{focused-full-word}\left[\begin{array}{ll}\text{PHON} & \boxed{1}\\ \text{SEM} & \boxed{2}\\ \text{NONLOCAL|INHERIT|FOCUS} & \left\{\left[\begin{array}{ll}\text{PHON} & \boxed{1}\\ \text{SEM} & \boxed{2}\end{array}\right]\right\}\end{array}\right]$$

With this general specification, the four rules can now be redefined in an extremely economical way. For instance, rule (17) is rewritten as follows:

(29) full-word[ ] ⟹ nonfocused-full-word[ ]
∨ focused-full-word[ ]

Although the rules (ii), (iv), (vi), and (viii) do not look exactly the same, they can also be subject to a modular definition. Let us first posit the rule below:

(30) focus-domain[ ] ⟹

$$\left[\begin{array}{ll}\text{NONLOCAL} & \left[\begin{array}{ll}\text{INHERIT|FOCUS} & \{\boxed{1}\left[\text{SEM|DRS}\ \boxed{2}\right]\}\\ \text{TO-BIND|FOCUS} & \{\boxed{1}\}\end{array}\right]\\ \text{PRAG|PRAGFOCUS} & \boxed{2}\end{array}\right]$$

Using this rule, the rules (ii), (iv), (vi), and (viii) can be further elaborated. For example,

(31) a. focused-vp[ ] ⟹
focus-domain[PHON|LAST-WORD|STRESSED +]

b. marked-focused-sentence[ ] ⟹

$$\text{focus-domain}\left[\begin{array}{ll}\text{PHON|LAST-WORD|STRESSED} & -\\ \text{NONLOCAL|INHERIT|FOCUS} & \langle\left[\text{PHON|STRESSED}\ +\right]\rangle\end{array}\right]$$

Using this PARAMETRIZED way of grammar specification made possible by the Typed Unification formalism, it becomes transparent what is common and what is different in the focus–related rules of one language. More importantly, it opens the way for comparative and/or universal study of focus from a formal perspective—in the above example, the focus-domain[ ] is needed both in Japanese and English to define the PFS of a sentence. However, it must be applied differently and also modified differently in terms of the phonological properties of focused elements.

7. CONCLUSION

I have shown that the Typed Unification approach to focus can formalize diverse components such as syntax, phonology, morphology, and lexicon in the same framework and can define interface between them in a clear and consistent way. Furthermore, this type-based formalism clears the way for a contrastive and universal study of focus and prosody on scientifically firm grounds.

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LIST OF ABBREVIATIONS

ACC	ADVS	CASL	CONT	EXPL	GEN	INTR
accusative	adversative	causal	contrastive	explicative	genitive	interrogative
LOC	NEG	NOM	POLT	SBJ	SIML	SUCC
locative	negative	nominative	polite	subject	simultaneous	successive
TOP						
topic						

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