A Typology in the Higher-Order Unification Approach to Ellipsis: The Implications of Japanese Post-Verbal Expressions
Author(s): Kazuhiko Fukushima
*Proceedings of the Nineteenth Annual Meeting of the Berkeley Linguistics Society: General Session and Parasession on Semantic Typology and Semantic Universals* (1993), pp. 381-389

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**Kazuhiko Fukushima** (e-mail: 22734kaz@msu.bitnet)
**Michigan State University**

## 1 Introduction

An English sentence like *Bill$_i$ likes his$_{i/j}$ wife, and Al$_j$ does too* is elliptical in that part of the second conjunct necessary for the proper interpretations of the entire sentence is left out. Less obvious but equally interesting instances of ellipsis (or 'gapping') are found in Japanese with respect to its post-verbal bound morphemes such as tense, modals, control morphemes, etc.[1] An example of such morphological gapping involving the tense morpheme *-ta* is given in (1). It is noted that, though there are two independent coordinated sentences in (1), both of which describe a state of affairs in the past (not necessarily simultaneous—more on this point below), the bound tense morpheme is attached only to the verb of the second conjunct. Thus the situation can be characterized as gapping of the tense morpheme from the first conjunct.

(1) [S Taroo -ga uta-i] (sosite) [S Hanako -ga odot-*ta*]
-NOM sing-CONJ (and) -NOM dance-PAST
'[S Taroo sang] and [S Hanako danced]'

Numerous attempts at ellipsis resolution (predominantly for English) found in the literature (Sag 1976, Williams 1977, Roberts 1987, Gawron and Peters 1990, McCawley 1993, among others) witness the intriguing complexity and tenacity of the phenomenon, which does not readily render itself to adequate linguistic analyses. Recently, a new approach to elliptical English sentences like our example above has been proposed by Dalrymple, Shieber, and Pereira (DSP) (1991). DSP's HIGHER-ORDER UNIFICATION approach (described below) departs from the common assumption on ellipsis resolution shared by the previous authors mentioned above in order to achieve a wider and more adequate coverage of the relevant facts.

Given such a new strategy, the first task of the present paper is investigating further applications of DSP's idea specifically to the interpretations of *bound* morphemes such as post-verbal expressions in Japanese. It is shown that the higher-order unification method offers a desirable account for morphological gapping in the language which, in particular, is able to solve morphology-semantics mismatch involving the post-verbal expressions. Thus the universality potential of DSP's system for ellipsis resolution is demonstrated. The second task of the paper is to shed light on cross- linguistic variations concerning the constraints on recoverability of 'elided' properties.

## 2 DSP on Ellipsis resolution

Let us come back to our English example (repeated in (2a)) and examine how ellipsis is dealt with in DSP's framework. For sentences like (2a), unlike their predecessors,

DSP presuppose no syntactic/semantic ambiguity of the source (*Bill likes his wife*) to attain the interpretations of the target (*Al does too*). *Properties* (P) that hold of the *parallel element* in the target (*Al*) is recovered from the source by solving the equation given in (2b) via higher-order unification. There are four possible solutions for the equation in question, indicated in (2c-f).

(2) a. Bill$_i$ likes his$_{i/j}$ wife and Al$_j$ does too

b. P(bill) = likes(bill,wife-of(bill))

c. λx.likes(bill,wife-of(bill))

d. λx.likes(bill,wife-of(x))

e. λx.likes(x,wife-of(bill)) [strict reading]

f. λx.likes(x,wife-of(x)) [sloppy reading]

In (2b), the parallel element in the source (*bill*) is underlined and is called the *primary occurrence*, which is given a special status with respect to abstraction. DSP stipulate that the primary occurrence has to be abstracted when solving an equation like (2b). This forces (2c) and (2d) to be discarded because the primary occurrence (*bill*) is not abstracted. The solutions in (2e) and (2f) correspond to 'strict' and 'sloppy' readings of the target, respectively. This difference obtains depending on whether the *secondary occurrence* (as opposed to the primary one) is abstracted or not. Now, applying (2e) and (2f) to *al* will produce strict and sloppy interpretations of the target.

# 3 Morphological ellipsis

Though DSP mention non-constituent and non-syntactic parallelisms in English, all relevant instances they offer seem to involve free morphemes. However, ellipsis involving bound morphemes is possible, as the Japanese example above suggests. To establish this point firmly, let us examine the relevant data involving the past tense morpheme *-ta* in more detail. (Other bound morphemes are introduced in section 4.2.) Gapping of the tense morpheme gives rise to an additional problem, namely morphology-semantics mismatch. Putative analyses for the tense gapping and the mismatch are also reviewed in this section and shown to be unsatisfactory.

## 3.1 Ellipsis and morphology-semantics mismatch

As seen in (3a,b), gapping of the past tense morpheme *-ta* can occur on different levels in a sentence. (The bracketing reflects the morphological structures.) In (3a) two IVPs are coordinated but only the second IVP is affixed with *-ta*. It is two Ss that are conjoined in (3b) and, again, the morpheme in question attaches to the verb of the second S. It is noted that the verbs in the first conjuncts of (3a,b) are in the conjunctive form, excluding the possibility of the attachment of *-ta* to them.

(3) a. Taroo -ga [IVP [IVP uta-i] (sosite) [IVP odot-*ta*]]
-NOM sing-CONJ (and) dance-PAST
'Taroo [IVP sang and danced]'

b. [S Taroo -ga uta-i] (sosite) [S Taroo -ga odot-*ta*]
-NOM sing-CONJ (and) -NOM dance-PAST
'[S Taroo sang] and [S Taroo danced]'

c. [PAST[Taroo sing] and PAST[Taroo dance]]

Contradicting the morphological bracketing, however, semantics requires—assuming that tense is an operator on tenseless Ss—(3c) for (3a,b). We need to have two distinct tense operators here since singing and dancing do not have to take place simultaneously.

A similar point can be made more vividly with transitive verbs. (4) involves coordination of TVPs, IVPs, and Ss. Here too, as the morphological bracketing indicates, only the verbs of the second conjuncts are suffixed with *-ta*. Semantics, of course, calls for different bracketing.

(4) a. Hanako -ga Taroo -o [TVP [TVP but-i] (sosite) [TVP kusugut-*ta*]]
-NOM -ACC hit-CONJ (and) tickle-PAST
'Hanako [TVP hit and tickled] Taroo'

b. Hanako -ga [IVP [IVP Taroo -o but-i] (sosite) [IVP Ziroo -o kusugut-*ta*]]
-NOM -ACC hit-CONJ (and) -ACC tickle-PAST
'Hanako [IVP [IVP hit Taroo] and [IVP tickled Ziroo]]'

c. [S Hanako -ga Taroo -o but-i] (sosite) [S Masako -ga Ziroo -o kusugut-*ta*]
-NOM -ACC hit-CONJ (and) -NOM -ACC tickle-PAST
'[S Hanako hit Taroo] and [S Masako tickled Ziroo]]'

## 3.2 Putative analyses

Let us examine what sort of analyses have been or might be formulated to accommodate the morphological ellipsis seen above.

### 3.2.1 Multiple entry analysis

The most straightforward analysis to account for the morphological property of the tense morpheme would be to suppose (assuming that no appeal is made to the use of empty pronominals—see below) that it *syntactically* selects a TVP (for (4a)), IVP (for (4b)), or S (for (4c)), regardless of the internal syntactic structure of the selected item. The morpheme *-ta* then cliticizes onto the rightmost verb of the selected item. However, this is unsatisfactory in three ways. First, phonologically and semantically identical but syntactically distinct multiple past tense morphemes have to be assumed. If we count ditransitive verbs (DTVPs), then there are totally four such entries. Moreover, as we see later, since other items such as the modal and control morphemes, etc. exhibit similar gapping properties, the multiple entry

analysis quickly ends up being very unattractive. Second, it fails to account for the morphology-semantics mismatch, except when *-ta* combines with an S. For other combinations (i.e., DTVP, TVP, and IVP), there have to be unmotivated semantic rules that interpret the tense morpheme at the S-level. Third, since there is only one tense morpheme, the analysis incorrectly predicts the simultaneity of the dancing and singing events, for example, in (3) above.

### 3.2.2 Empty pronominal analyses

Introducing an empty pronominal, *pro*, might seem to solve the problem easily. Such an element occupies the argument positions in the absence of phonetically realized subjects and objects. Thus an analysis employing *pro* is able to retain the position that tense is an S-operator—all the seemingly diverse gapping cases seen above can be subsumed under sentence coordination. All that has to be said is that the tense morpheme *syntactically* selects an S (coordinated or otherwise) and a morphological rule 'hops' *-ta* on the rightmost verb of the S that it has selected. Two versions of such an analysis come to mind immediately: One is what is actually suggested by Steele *et al.* (1981) and the other is an account similar to Van Valin's (1986) proposal for a null subject in English.

To account for cases like (3a), Steele *et al.* (1981) propose (in essence) a structure like (5) in which *-ta* syntactically selects and combines with coordinated Ss and takes scope over both. The subject positions of the conjoined Ss are occupied by empty pronominals with which the subject *Taroo* in an unknown structural position is to be coreferential.

(5) *pro* analysis version 1

Taroo$_i$-ga [s [s *pro*$_i$ utai] (sosite) [s *pro*$_i$ odot]]-*ta*

Alternatively, if we follow Van Valin (1986), (3a) will be analyzed as in (6) below. The cases involving object gapping are treated accordingly by either version.

(6) *pro* analysis version 2

[s [s Taroo$_i$-ga utai] (sosite) [s *pro*$_i$ odot]]-*ta*

Though both *pro* analyses above are able to retain the S-operator status of tense, there are shortcomings of these. First, such analyses encourage the proliferation and unconstrained use of empty pronominals that is difficult to motivate empirically. (See Iida (1992) for empirical evidence against *pro* in Japanese.) Version one, in addition, has to motivate the unorthodox complex embedding structure. Second, as pointed out Van Valin himself, *pro* in these examples is expected to behave as dictated by Principle B of GB Binding Theory—it can be coreferential with any NP outside of its governing category. But *pro* here indeed acts as an anaphor. In (6), for example, *pro* cannot refer to anybody but Taroo. Replacing *pro* with *PRO* will betray the original motivation of using *pro*, which appears in governed positions.[2] Third, as the first putative analysis above, either version predicts that the two events expressed by the conjoined Ss have to take place simultaneously. After all, there is only one tense operator employed here. This is a false prediction.

### 3.2.3 LF morpheme-raising analysis

A third possible analysis can be formulated according to Kitagawa's (1986) proposal. He proposes that the effect of morphology, e.g., the attachment of the tense morpheme in the lexicon, can be 'undone' in LF and the detached tense morpheme can (and in fact, must) be raised to the level where its *syntactic* subcategorization is satisfied. This analysis allows us to treat simple IVP or TVP coordination as is, not as coordination of Ss. Kitagawa's approach shares a core assumption about morphology with the current proposal offered below—all morphological processes are lexical and the attachment of bound morphemes occurs in the lexicon. A Kitagawa-type analysis will map an S-structure like (7a) to an LF representation like (7b). We see that *-ta* is morphologically part of the verb *odot-ta* in (7a) but is raised in (7b) from the IVP-internal position to the outside of the entire S, selecting and taking scope over the S. This in effect treats tense as an S-operator.

(7) a. SS: [$_S$ Taroo-ga [$_{IVP}$ [$_{IVP}$ utai] (sosite) [$_{IVP}$ odot-*ta*]]]

b. LF: [$_S$ Taroo-ga [$_{IVP}$ [$_{IVP}$ utai] (sosite) [$_{IVP}$ odot $t_i$]]]-$ta_i$

Simple and attractive though it may appear to be, there are problems with such an account. First, again, the single tense operator will incorrectly predict the simultaneity of the dancing and singing events as do the two analyses above. Second, and more seriously, the movement of *-ta* from within the innermost IVP violates the coordinated structure constraint, which is to be observed even in LF. In summary, none of the putative analyses reviewed here appears to be satisfactory.

## 4 Current proposal

Having examined the properties of morphological ellipsis involving the past tense marker *-ta* and establishing that the putative accounts fail, we are ready to explore a new account based on DSP's higher-order unification framework. Let us begin with the current assumptions.

(8) Assumptions

a. All morphological processes (including tense affixation) are located in the lexicon.

b. Coordination takes place in syntax.

c. Only a (lexically) tensed verb carries the tense operator.

### 4.1 Analysis of tense ellipsis

Let us consider (3a) (repeated in (9a)). (Again, the example reflects the morphological properties.)

(9) a. Taroo -ga [IVP [IVP utai] sosite [IVP odot-*ta*]]
-NOM sing and dance-PAST
'Taroo [IVP sang and danced]'

b. λx.(sing(x)) [first conjunct]

c. λy.PAST(dance(y)) [second conjunct]

d. λx.[(sing(x))&PAST(dance(x))]

e. (sing(taroo)) & PAST(dance(taroo))

The semantic (lexical) translations for the verbs of the first and second conjuncts are given in (9b) and (9c), respectively. (I represent the semantics of the Japanese examples using English glosses.) Only the latter conjunct carries the tense operator in accord with the first assumption above. When the coordinated IVP is formed in syntax, its translation will be (9d). Applying *taroo* to this gives (9e). Since tense in the first conjunct (i.e., the target) is gapped but necessary for the interpretation of the entire S, it has to be recovered and applied to the parallel element of the target which is the S itself, since the parallel elements here are the two tenseless Ss. The tenseless S in the second conjunct is the primary occurrence. The relevant property P to be recovered is (10b), gotten by solving the equation in (10a). The application of this to the target yields the complete interpretation (10c) for the entire S. It is easy to see that other examples introduced above are accounted for similarly.

(10) a. P(dance(taroo)) = PAST(dance(taroo))

b. P $\Longrightarrow$ λS.(PAST(S))

c. PAST(sing(taroo)) & PAST(dance(taroo))

We note the following three points about the proposed account. First, the desired reading (10c) is obtained from the 'surface' string without supposing multiple lexical entries of a single tense suffix, unmotivated empty pronominal elements, or the problematic assumption of morpheme raising in LF. Second, a recovered (i.e., elided) property is not limited to those corresponding to free morphemes. It is suggested that, in principle, any *semantically potent* property should be recoverable via higher order unification (modulo abstraction of the primary occurrence(s)) regardless of its free/bound morphological status. Third, however, relevant properties represented by bound morphemes are not recovered randomly. To this last point we turn immediately.

## 4.2 Constraints on morphological ellipsis resolution

The need for more constraints on the recoverability of gapped properties corresponding to bound morphemes is obvious from the following contrast in (11) involving the control verb *hazime* 'begin' and the modal *daroo* 'might' in addition to the familiar tense marker *-ta*. (The English translations below do not accurately depict what

the morphemes in question mean. Please consult the gloss carefully.) We see that all three morphemes in question can be gapped from and recovered for the target in (11b) (call this the strict reading). Also, as in (11c), it is possible to recover only the modal and tense for the target (call this the sloppy reading). However, recovering the control verb and tense in the absence of the modal is not allowed as (11d) attests.

(11) a. [S Taroo -ga utai] sosite [S Ziroo -ga odori-*hazime-ta-daroo*]
-NOM sing and -NOM dance-BEGIN-PAST-MIGHT

b. 'Taroo *might have begun* to sing and Ziroo *might have begun* to dance' [strict reading]

c. 'Taroo *might have* sung and Ziroo *might have begun* to dance' [sloppy reading]

d. ≠ 'Taroo *had begun* to sing and Ziroo *might have begun* to dance' [impossible reading]

The strict reading property in (12b) below needed for (11b) is gotten by abstracting only the primary occurrences, *dance* and *ziroo* in the interpretation of the source given in (12a). Note that the first argument of the control predicate BEGIN, *ziroo*, has to be abstracted as well, though it is not primary. This is due to the independent lexical property of the control predicate the subject argument of which has to be identical to that of the embedded property *dance*. Applying this to *taroo* and *sing* will obtain the desired strict reading of the target: MIGHT(PAST(BEGIN(taroo, sing(taroo)))).

(12) a. MIGHT(PAST(BEGIN(ziroo, dance (ziroo))))

b. λP.λx.MIGHT(PAST(BEGIN (x, P(x))))

c. λQ.λP.λx.MIGHT(PAST (Q(x, P(x))))

The sloppy reading property (12c) for (11c) is the result of the abstraction over not only the primary occurrences, *dance* and *ziroo*, but also a secondary occurrence, namely the control property BEGIN. There is a technical problem here in applying the recovered property (12c) to the parallel elements of the target—there are not enough parallel elements! What we need is some property that discharges the first argument of (12c) corresponding to a control predicate. I propose that the following property, PLAIN, in (13a) does this job. With this the target interpretation for (11c) is translated as in (13b).[3]

(13) a. PLAIN: <x, P(x)> ↦ P(x)

b. MIGHT(PAST(SING(taroo)))

With respect to the contrast in (11b-d), we observe that tense (unlike the control verb) cannot be skipped when recovering a property of the parallel element(s) of the target. This seems to be a general semantic requirement that tense is needed (hence obligatorily recovered) for interpreting an independent sentence. However, at the moment, nothing predicts the impossibility of (11d). What seems to be going on is that items (e.g., the modal) taking scope over the obligatorily recovered property (e.g., tense) have to be recovered along with it. It is suggested that these two additional observations concerning optional/obligatory recovery of a given property should also be incorporated into DSP's system of ellipsis resolution to adequately cover bound morphemes.

(14) More constraints on property recovery with respect to bound morphemes

- Elements necessary for a proper interpretation (like tense but unlike control predicates) cannot be abstracted (i.e., 'skipped') when recovering a property of the parallel element(s) of the target.
- Bound morphemes (such as the modal) taking scope over an obligatorily recovered property have to be recovered along with it.

# 5 Concluding remarks

We have seen an account for morphological gapping involving post-verbal expressions in Japanese based on DSP's framework of higher-order unification. The account is desirable in that it offers a simple solution for one kind of morphology-semantics mismatch which is problematic for the alternative analyses reviewed above. In addition to solving the empirical problems, this paper entertained the question concerning the range of recoverability of semantically potent properties when DSP's system is applied specifically to bound morphemes. It was suggested that with the additional constraints on parallelism and property recoverability noted in the previous section, DSP's system is capable of being applied to a wider range of phenomena and languages. However, the preliminary nature of the present study is obvious not only from the fact that the set of bound morphemes in Japanese examined excluded other significant members such as passives, causatives, benefactives, etc. but also from the limited number of languages examined—namely one.

# Notes

[1]We can also find ellipsis of a 'regular' flavor similar to the English example:

(i) Taroo -ga okaasan -o tasuke-ta, Ziroo -mo soo si-ta
-NOM mother -ACC help-PAST -also so do-PAST
'Taroo helped his mother and Ziroo did so too'

Relevant though it may be to the discussion of ellipsis in Japanese, this type of ellipsis is ignored. It is not difficult to see how an account along the lines of Dalrymple, Shieber, and Pereira (1991) (see below) can be furnished.

[2]Godard (1989) points out more problems with empty pronominal subjects in English.

[3]It is not the case that PLAIN is devised to save only this particular example. It can be widely used for gapping involving other (subject) control predicates: *-tai* 'want', *-temiru* 'try', etc. Also, for English examples like (i) mentioned by DSP (their (35a)), something like PLAIN is needed.

(i) "I want to leave." "Well, do"

In addition to the difference in mood between the first and second utterances, we note that the elided property for the second utterance is not *want to leave* but rather *leave*. Thus it is necessary to 'skip' *want (to)* when recovering the elided property.

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