A Study on Auxiliary Verb Negation in the GPSG Framework

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1. INTRODUCTION

The theory of Generalized Phrase-Structure Grammar (henthforth GPSG) developed out of work by Gerald Gazdar at the end of 1970s and since then the details of the theory have changed with the works of Gerald Gazdar himself, I. A. Sag, G. K. Pullum and other linguists. GPSG allows only context free system. While the emphasis in the development of transformational grammar in GB theory was on constraining the transformational component, GPSG simply eliminates the transformational component and claims that one level of syntactic representation, surface structure, will suffice and that in so doing GPSG can solve several long-standing problems. GPSG has inherited a tradition from formal language theory, mainly Montague Grammar. Every syntactic structure is directly paired with a semantic interpretation. The overall picture of the grammar is shown in Figure 1 (Peter Sells:1985;79).

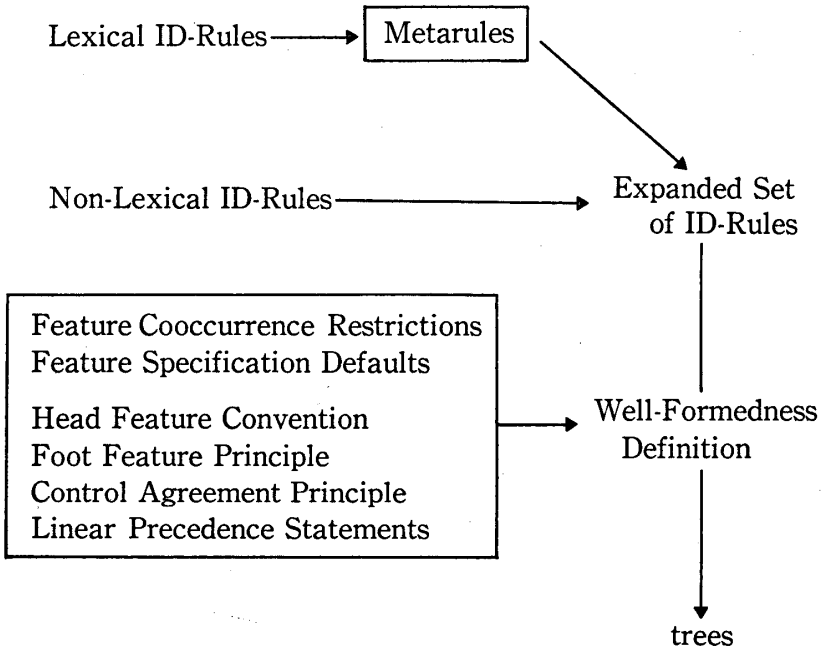


Figure 1

GPSG relies on the information around the trees, which is encoded by means of

syntactic features. For example, there might be a feature specification on a given node that indicates it has a TENSE feature with the value PAST, and an identical specification on the mother of this node. A syntactic category in GPSG is taken to be set of feature-value pairs. For example, the label NP($\bar{\bar{N}}$) is taken to be an abbreviation for the set {<N,+><V,−><BAR,2>} where BAR is a feature. Categories are taken to be partial functions from features to values.

In this paper, *not* after an auxiliary verb will be studied from the syntactic viewpoint in chapter 2. In chapter 3, relative scope of negation and modal verbs and that of negation and adverbs will be studied from the viewpoint of semantics. The study will be based mainly on Gazdar, Pullum & Sag (1982) in the GPSG framework. In chapter 4, conclusion and some problems will be described.

2. SYNTACTIC ANALYSIS

Gazdar et al. (1982;604) proposes the following rule scheme which will introduce negation into tenseless $\bar{V}$ (VP).

$$<14, [_{\bar{V}}\ \textit{not}\ \bar{V}],\ \lambda\ \mathscr{P}\ [\sim\bar{V}'(\mathscr{P})]> \quad \begin{bmatrix} -\text{FIN} \\ \pm\text{NUL} \end{bmatrix}$$

In rule [14] above, the left [ ] -part indicates syntactic structure and the right part following λ indicates its semantic translation rule. As shown in [−FIN], *not* is introduced before tenseless $\bar{V}$ and the scope of *not* is defined within $\bar{V}$ following it. By adding the feature [±NUL], VP deletion sentences can be generated, which will be discussed later in this paper. Gazdar et al. (1982:604) says rule [14] allows us to generate the following examples.

(1) Kim did not drink.
(2) Kim may not have been drinking.
(3) Kim may have not been drinking.
(4) Kim may have been not drinking.
(5) Kim wanted not to drink.
(6) Kim wanted to not drink.
(7) Kim is not stupid.
(8) Kim was not taken by Sandy.

First of all, the trees of sentence (1) and (2) will be illustrated as shown below.

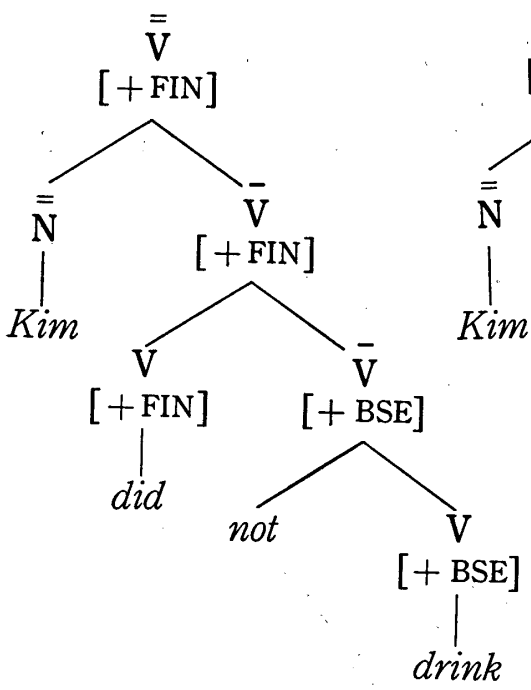


Figure 2 (tree of (1))

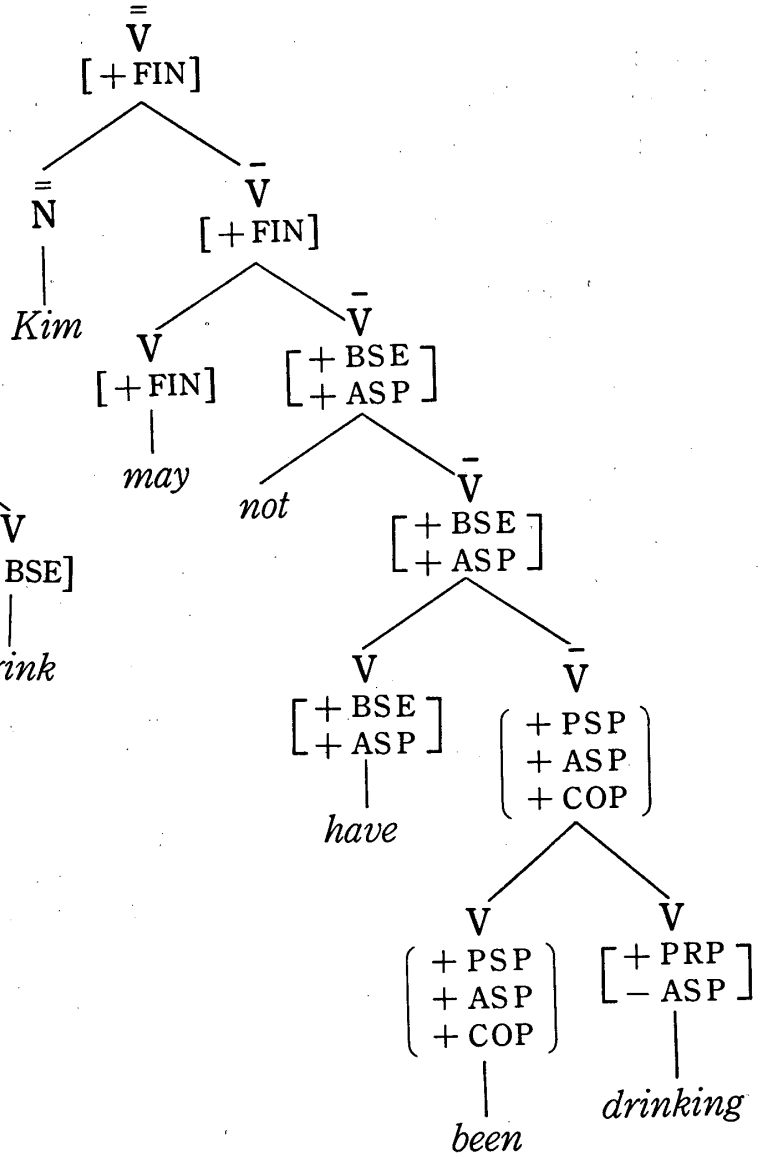


Figure 3 (tree of (2))

The meaning of the feature in [ ] is as follows:

+FIN: the head V of the $\overline{V}$ is tensed (*hates cauliflower*).

+BSE: the head V of the $\overline{V}$ is a bare infinitive (*be tall*).

+PRP: the head V of the $\overline{V}$ is a present participle (*going away*).

+PSP: the head V of the $\overline{V}$ is a past participle (*gone away*).

+PAS: the $\overline{V}$ is a passivized VP (*eaten by a bear*).

+GER: the head V of the $\overline{V}$ is a gerund(ive) (*having gone away*).

+INF: the $\overline{V}$ is an infinitive phrase with to (*to go away*).

+PRD: the $\overline{V}$ consists merely of a predicational $\overline{\overline{X}}$ (*so nice a man* ($\overline{\overline{N}}$), *in the garden* ($\overline{\overline{P}}$), *easy to please* ($\overline{\overline{A}}$)).

+AUX: the head V of the $\overline{V}$ is an auxiliary verb (*doesn't matter*).

+ASP: the head V of the $\overline{V}$ is an aspect-marking verb (*is going away, has*

gone away).

+COP: the head V of the $\bar{V}$ is the copula (*is a cat, be singing*).

+NUL: the $\bar{V}$ is realized as the empty string e.

+INV: a $\bar{\bar{V}}$ marked +INV is a sentence beginning with a tensed 'inverted' auxiliary (*Are'nt I clever!*)

Next, sentence (5) and (6) will be discussed. *To* is taken to be of the category [+V,+AUX, +INF] and *to drink* is considered $\bar{V}$. Sentence (5) and (6) will be illustrated as shown in Figure 4 and 5.

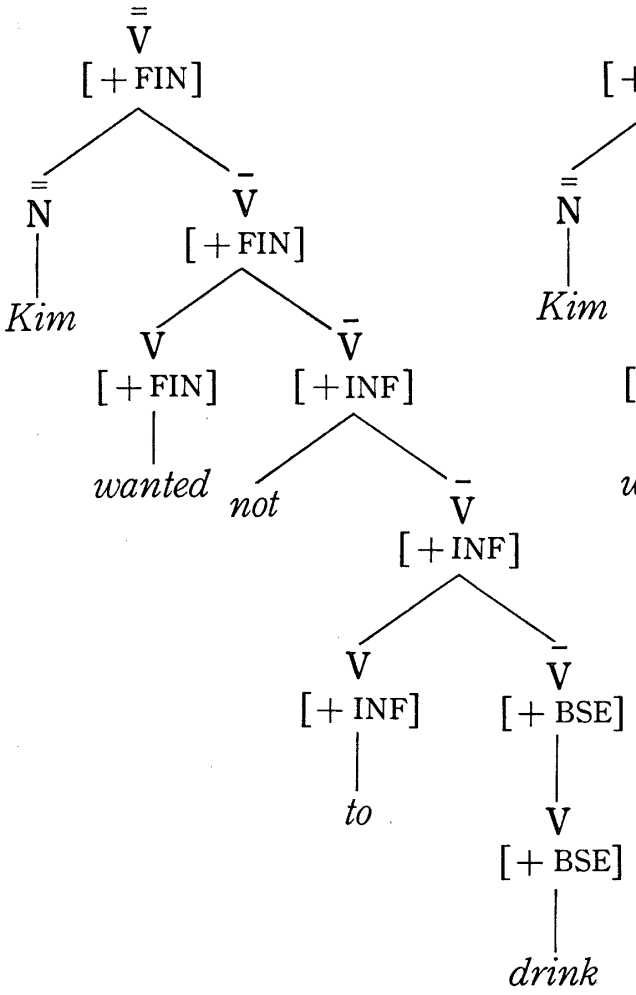


Figure 4 (tree of (5))

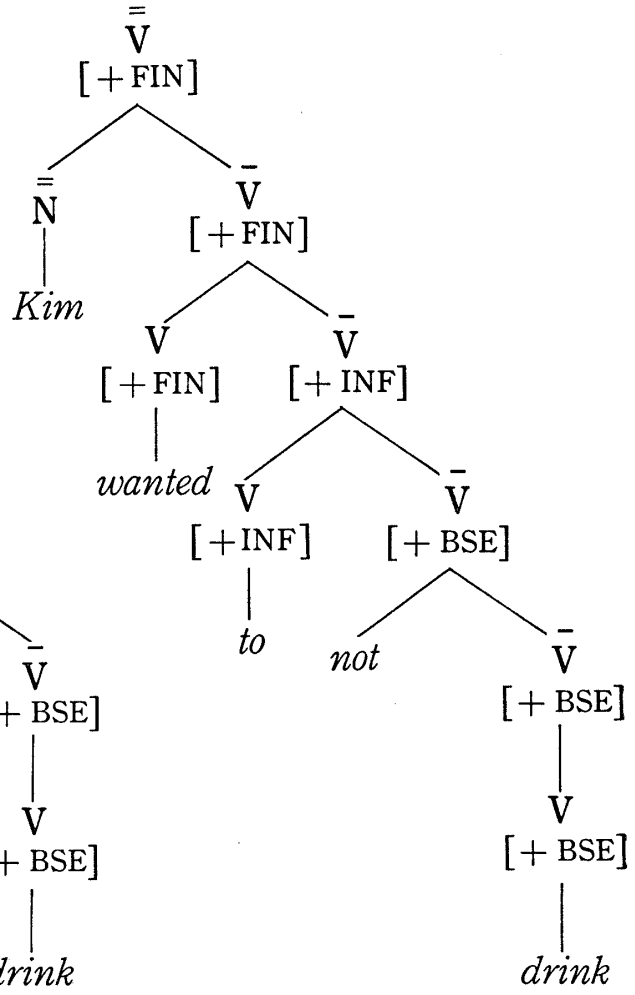


Figure 5 (tree of (6))

Before sentence (7) is studied, rule (9) (Gazdar et al.: 1982;598, 599) and rule (10) (Ibid.; 601) should be studied.

$$\left\langle 9,\ \left[\bar{V}\ \ V\ \ \bar{V}\right],\ \lambda\mathscr{P}\ \left[V'\ \left(\wedge\bar{V}'\ \left(\mathscr{P}\right)\right)\right]\right\rangle$$
$$\begin{matrix}\left[+\text{COP}\right]\left[+\text{PRD}\right]\\ \left[+\text{AUX}\right]\end{matrix}$$

$$\left\langle 10,\ \left[\bar{V}\ \ \bar{\bar{X}},\cdots\right]\right\rangle \ \textit{where}\ X\in\{A,N,P\}$$
$$\left[+\text{PRD}\right]$$

As shown above, the feature [+PRD] is assigned to *stupid* in (7) and $\bar{A}$ is consid-

ered $\bar{V}$ and the tree of (7) will be illustrated in Figure 6 below. In sentence (9) *Kim is not an American.*, the feature [+PRD] is assigned to $\bar{\bar{N}}$ and (9) is generated from rule [14] as shown in Figure 7 below.

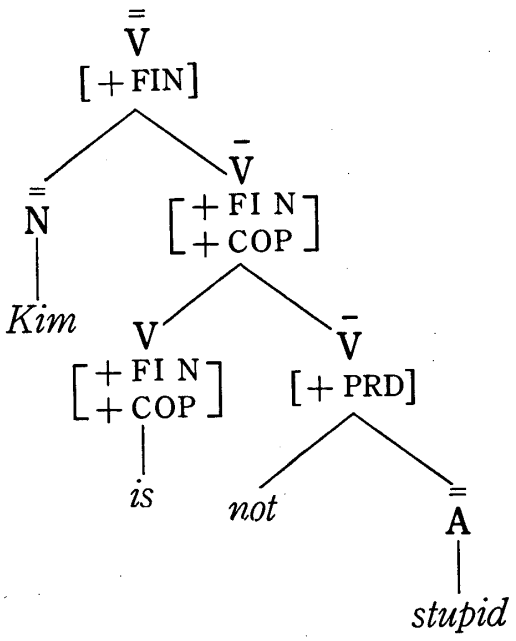


Figure 6 (tree of (7))

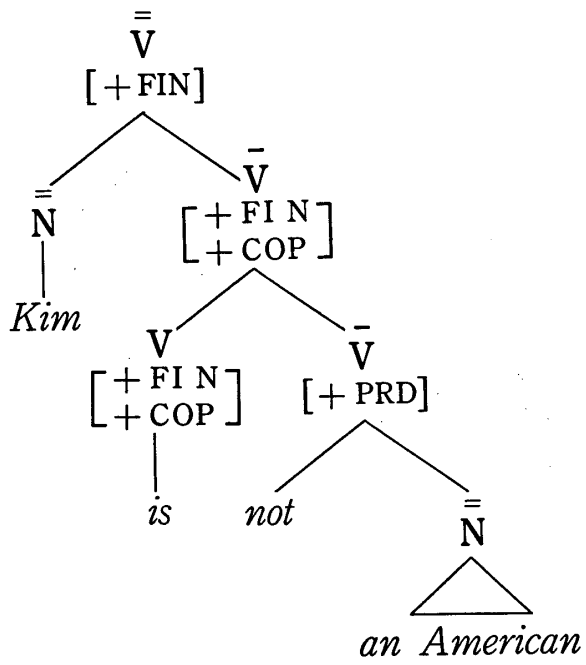


Figure 7 (tree of (9))

Next, let us consider such a passive sentence as (8). Passive sentences are introduced by the following metarule in the GPSG framework which does not allow transformational component.

$$\langle [_{\bar{V}}\ V\ \bar{\bar{N}}\ X],\ \mathscr{F}(\bar{\bar{N}}'')\rangle \Rightarrow$$
[+TRN]

$$\langle [_{\bar{V}}\ V\ X\ (\bar{\bar{P}})],\ \lambda\mathscr{P}[\mathscr{F}(\mathscr{P})(\bar{\bar{P}}'')]\rangle$$
[+PAS] [by]

According to the metarule above, *Kim was taken by Sandy* is introduced and sentence (8) will be generated by applying rule [14] to it.

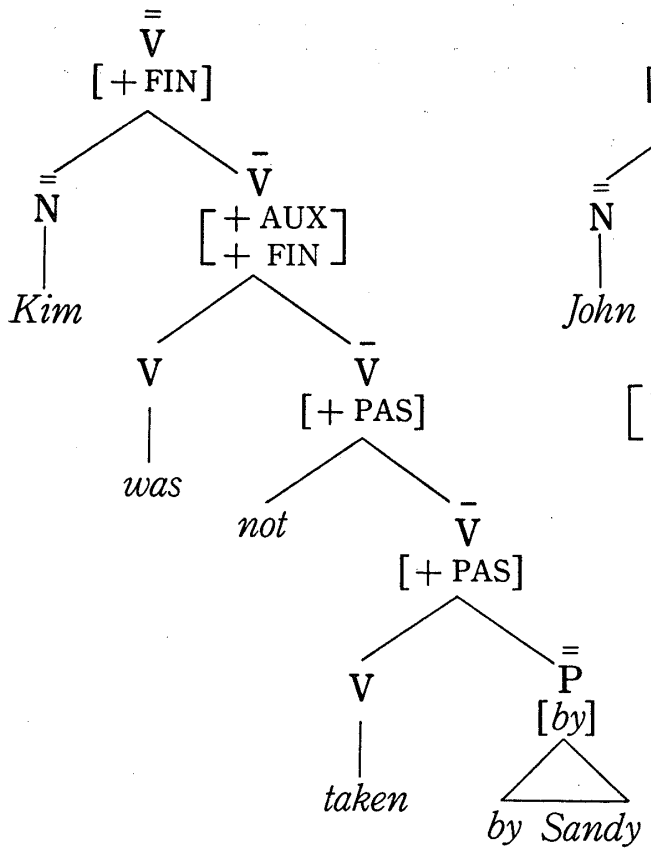


Figure 8 (tree of (8))

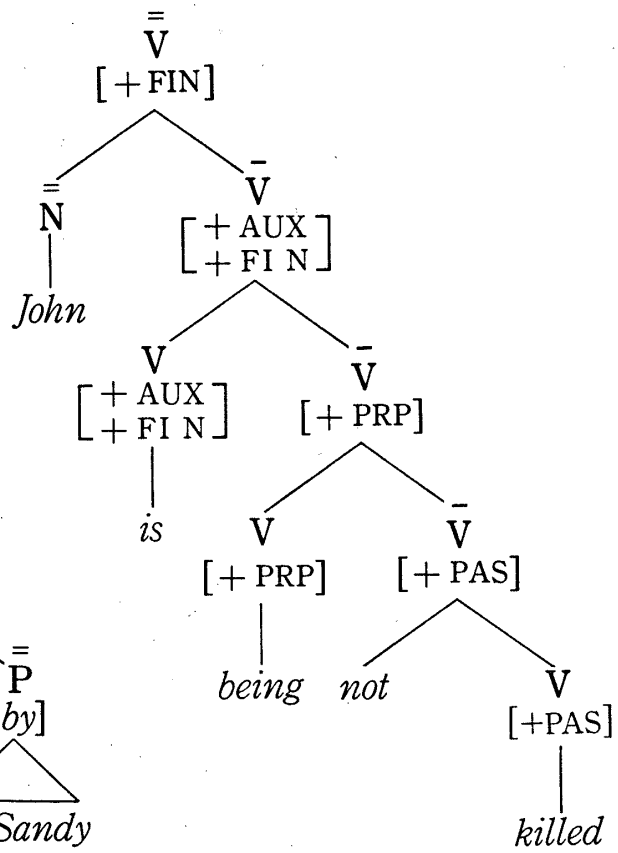


Figure 9 (tree of (10))

Sentence (10) *John is being not killed*, which was difficult to be generated in the transformational framework (Amano:1980;124) can also be generated quite easily as shown above.

Next, negative VP deletion sentences will be studied. In the GPSG framework, deletion operations are not permitted and as shown in rule (16)(Gazdar et al.:1982; 606) below, *null* plays a crucial role.

$$\underset{[+\mathrm{NUL}]}{\langle 16, [\bar{\mathrm{V}}\ e], v\rangle}$$

Here, v is a contextually bound variable ranging over $\bar{\mathrm{V}}$ denotations. And then the following metarule is formulated.

$$\mathrm{VPD}: \langle\ [\bar{\mathrm{V}}\ \mathrm{V}\ \bar{\mathrm{V}}], \mathscr{F}\rangle \Rightarrow$$

$$\begin{bmatrix} +\mathrm{AUX} \\ -\mathrm{PRP} \\ -\mathrm{GER} \end{bmatrix}$$

$$\underset{[+\mathrm{NUL}]}{\langle\ [\bar{\mathrm{V}}\ \mathrm{V}\ \bar{\mathrm{V}}], \mathscr{F}\rangle}$$

By using rule (14) and VPD metarule above, the following sentence can be generated.

(11) My brother went to the party but I did not.

The tree diagram of the underlined part of the sentence (11) is as follows:

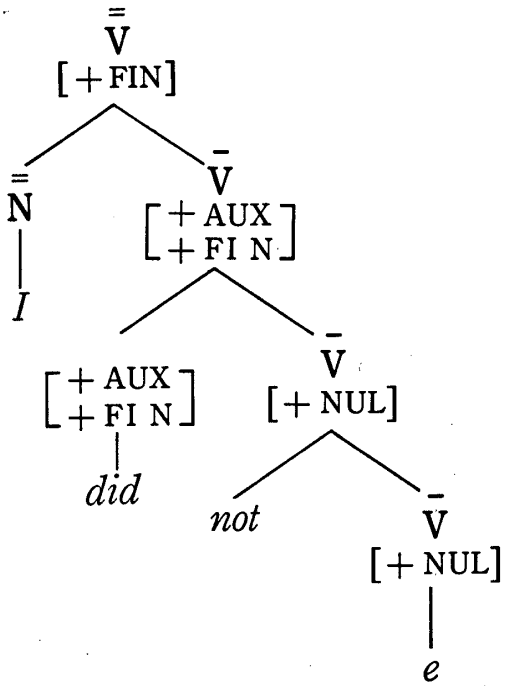


Figure 10

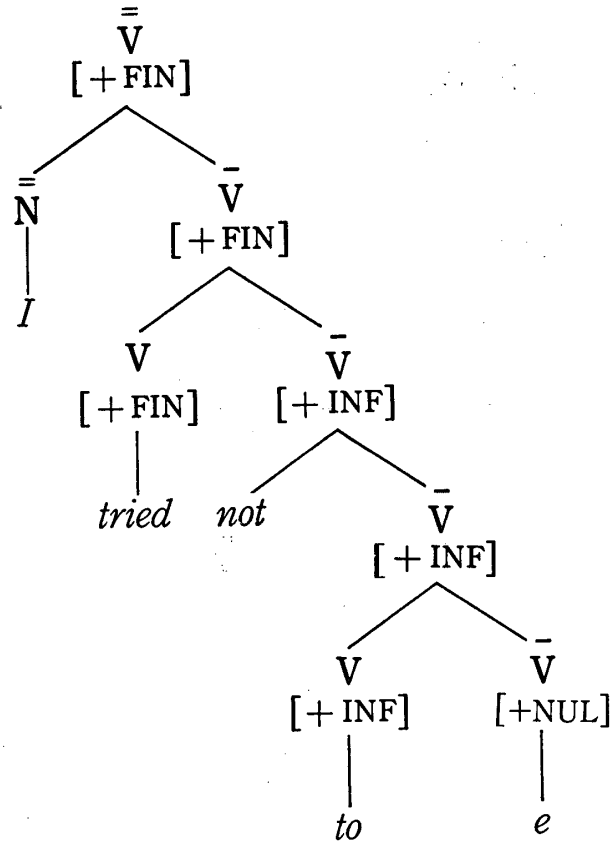


Figure 11

The underlined part of the following sentence (12) can also be easily generated in the same way.

(12) I burst out laughing though I tried not to.

Next, subject-auxiliary inverted negative sentences will be studied. Gazdar et al. (1982:608) formulates the following metarule on subject-auxiliary inversion.

$$\text{SAI}: < \begin{bmatrix}\bar{V}\\ +\text{FIN}\\ +\text{AUX}\end{bmatrix}\ V\ \begin{bmatrix}\bar{V}\\ \alpha\end{bmatrix},\ \lambda\mathscr{P}[V'(\wedge\bar{V}'(\mathscr{P}))] > \Rightarrow$$

$$< \begin{bmatrix}\bar{V}\\ +\text{INV}\end{bmatrix}\ V\ \begin{bmatrix}\bar{\bar{V}}\\ \alpha\end{bmatrix}, V'(\wedge\bar{\bar{V}}') >$$

By using rule (14) and SAI metarule, the following sentences can be generated as shown below.

(13) Can Kim not go?

(14) Has Kim not been going?

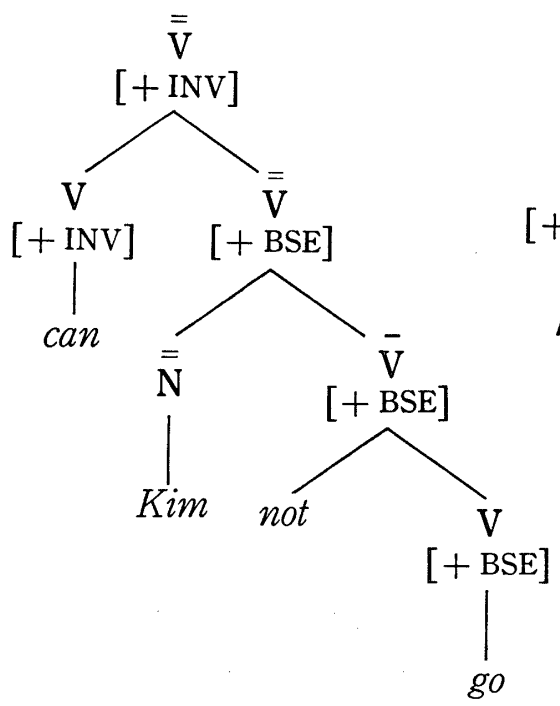


Figure 12 (tree of (13))

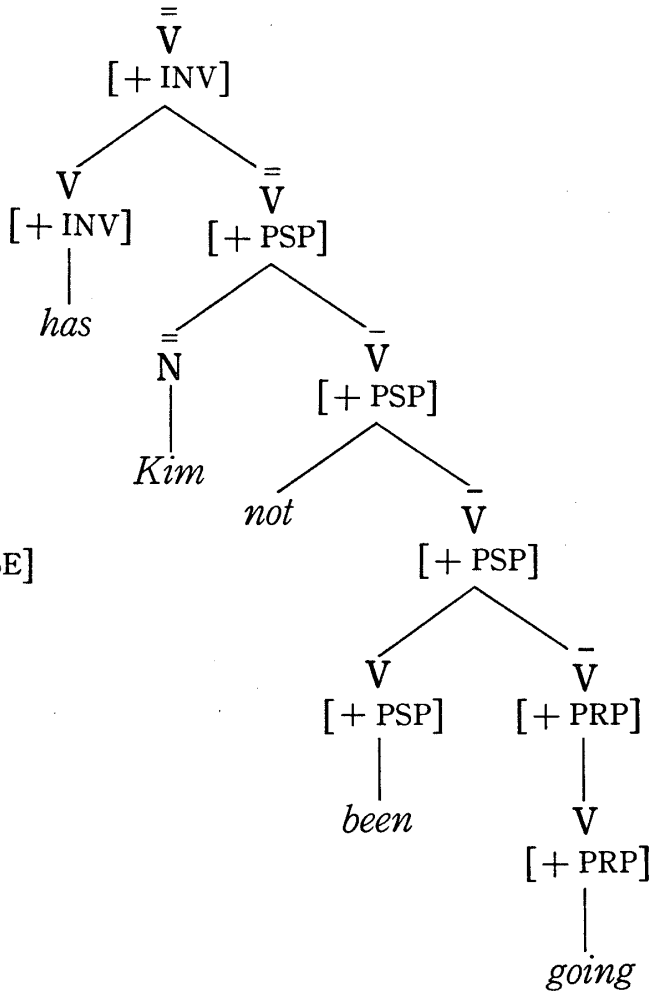


Figure 13 (tree of (14))

In chapter 2, it has been shown that auxiliary verb negation, negation of *to* infinitive, negation of passive sentence (including passive progressive sentence), VPD negative sentencea and SAI negative sentence can be generated in the GPSG framework. In chapter 3, negation will be studied from the viewpoint of semantics with the focus on the problem of scope.

3. SEMANTIC ANALYSIS

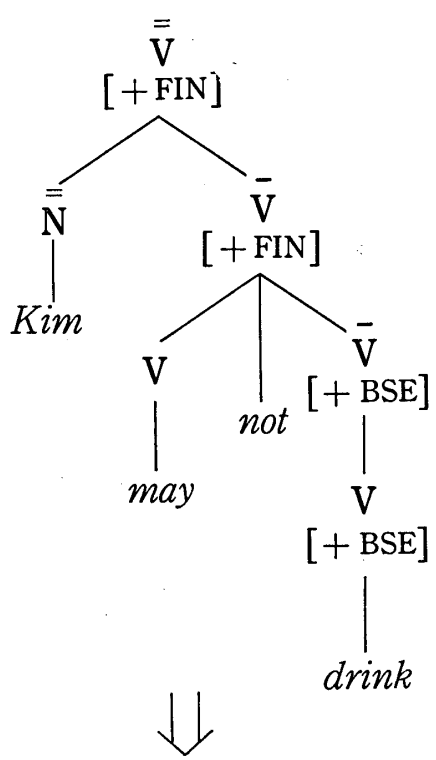
First of all, *not* after a modal auxiliary will be studied. Gazdar et al. (1982;604) claims that sentence (15) *Kim may not dnink* is ambiguous having two readings (15a) and (15b) respectively.

(15a) Kim is not permitted to drink.
(15b) Kim is permitted not to drink.

To solve the ambiguity of sentence (15), Gazdar et al. (1982:605) formulates lexically governed rule [15] in addition to rule [14].

$<15,\ [\bar{v}\ \ V\ \textit{not}\ \bar{V}],\ \lambda\mathscr{P}[\sim V'(\wedge\bar{V}'(\mathscr{P}))]>$
$\quad\ \begin{bmatrix}+\text{AUX}\\+\text{FIN}\end{bmatrix}\quad [+\text{BSE}]$

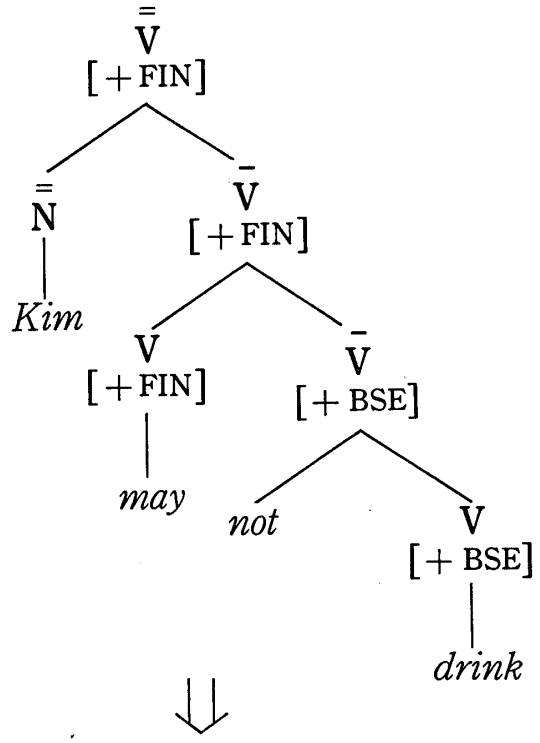
By applying rule [14] and rule [15] respectively, the ambiguity of sentence (15) can be readily accounted for in the following way.



$[\lambda\mathscr{P}(\sim may'(drink'(\mathscr{P}))]\ (Kim')$

Kim is not permitted to drink.

Figure 14 (application of rule (15))



$[\lambda\mathscr{P}\ may'((\sim drink'(\mathscr{P}))](Kim')$

Kim is permitted to not drink.

Figure 15 (application of rule (14))

Two kinds of semantic interpretation of sentence (15) has also become clear as seen in the semantic translation rules of the formula above.

Next, the relation between *not* and an adverb will be studied. According to Quirk et al. (1972;421), adverbs can be divided into two classes, distinguished by whether or not they are integrated to some extent into the structure of the clause. Those that are integrated to some extent are termed adjuncts. Those that are peripheral to clause structure are subdivided into disjuncts or conjuncts: the distiction between these two is that conjuncts have primarily a connective function. Figure 16 summarizes the distinctions we have just made.

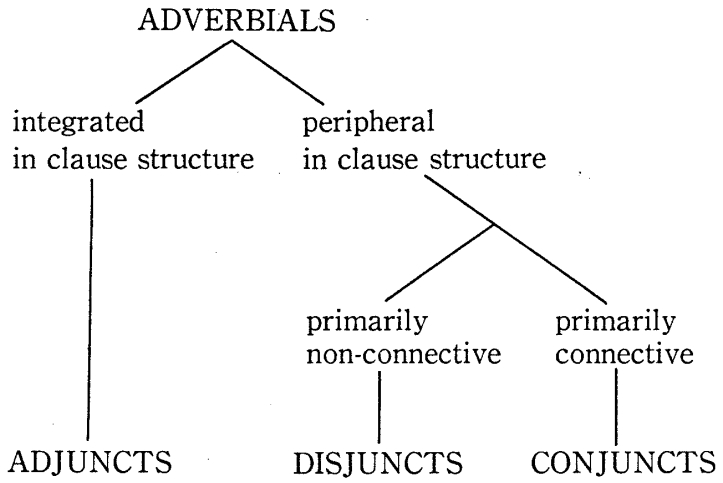


Figure 16

A conjunct adverb has primarily a connective function. Such adverbs as *incidentally, however, therefore, besides etc.* belong to this group and they have nothing to do with negation in the sentence syntactically and semantically. Therefore, they will not be discussed here. An adjunct adverb is integrated in clause negation and can be the focus of negation. Such abverbs as *intentionally, reluctantly, carefully, quickly, slowly, gradually, easily etc.* belong to the adjunct group. Sentence (16a) is grammatical but sentence (16b), (16c) and (16d) are ungrammatical.

(16a) John does not run quickly.
* (16b) Quickly John does not run.
* (16c) John quickly does not run.
* (16d) John does not run, quickly.

The adjunct abverb *quickly* should be within the scope of negation and when it is taken outside the scope of negation, the sentence is ungrammatical. The meaning of sentence (16a) is something like *John ran but not quickly* and here *quickly* is the focus of negation.

Next, disjunct adverbs will be discussed. A disjunct adverb appears initially or before an auxiliary and its scope is wider than that of negation. Such adverbs as *frankly, honestly, briefly, (un)fortunately, happily, necessarily, probably etc.* belong to the disjunct group, though some of them have the conjunct function, too. Sentence (17a), (17b), and (17c) are grammatical but sentence (17d) are ungrammatical.

(17a) Probably John will not come home.
(17b) John probably will not come home.
(17c) John will not come home, probably.
* (17d) John will not probably come home.

In (17a), (17b) and (17c), *probably* is outside the scope of negation; in other words, *probably* has wider scope than *not*. Therefore, they are grammatical but in sen-

tence (17d), *probably* is within the scope of negation and it is ungrammatical.

As seen above, there is a close relation between abverbs and negation. Next, the formalization and explanation of the relation will be attempted in the GPSG framework. First of all, an adjunct adverb will be translated ξ and a disjunct adverb will be translated δ. ξ and δ should have the condition $\sim > \xi$ and $\delta > \sim$, where $\sim$is *not*. The underlined part of (16a) will be translated as follows.

(16a) John does <u>not run quickly.</u>

(16a') *not* [*run quickly*]

$\Downarrow$

$\lambda\mathscr{P}$ [$\sim$*run' quickly'* ($\mathscr{P}$)]

$\Downarrow$

$\lambda\mathscr{P}$ [$\sim\bar{V}'$ ξ ($\mathscr{P}$)]

where ξ is the semantic interpretation of quickly and has the condition, $\sim > \xi$.

(16b) and (16c) will be translated as follows:

(16b')
(16c') ξ [$\lambda\mathscr{P}$ [$\sim\bar{V}'$ ($\mathscr{P}$)]

(16d) will be translated as follows:

[$\lambda\mathscr{P}$[$\sim\bar{V}'$ ($\mathscr{P}$)]] ξ

As shown in the translation above, in (16a') an adjunct adverb ξ is indeed within$\sim$ *not* and on the contrary, in (16b'), (16c') and (16d'), ξ is outside $\sim$ *not* and they are against the condition $\sim > \xi$. Next, the underlined part of (17a) will be translated in the following way.

(17a) Probably John will <u>not come home.</u>

(17a') *probably* [*not* [*come home*]]

$\Downarrow$

probably' [$\lambda\mathscr{P}$[$\sim$*come' home'* ($\mathscr{P}$)]]

$\Downarrow$

δ [$\lambda\mathscr{P}$[$\sim\bar{V}'$ ($\mathscr{P}$)]]

where δ is the semantic interpretation of probably and has the condition, $\delta > \sim$.

The translation of (17b) and (17c) will be as follows:

(17b') δ [$\lambda\mathscr{P}$[$\sim\bar{V}'$ ($\mathscr{P}$)]]

(17c') [$\lambda\mathscr{P}$[$\sim\bar{V}'$ ($\mathscr{P}$)]] δ

In (17a'), (17b') and (17c'), δ, a disjunct adverb has wider scope than $\sim$ *not* and they meet the condition, $\delta > \sim$. Therefore, they are grammatical. Sentence (17d) will be translated as follows:

(17d') $\lambda\mathscr{P}$[$\sim\bar{V}$ δ ($\mathscr{P}$)]

Here, a disjunct adverb δ is within the scope of negation and doesn't meet the condition, $\delta > \sim$. Thus the ungrammaticality of sentence (17d) can be explained. As discussed above, the GPSG framework can explicitly account for the grammaticality of the sentence with regard to the scope of negation by adding some new scheme. This is mainly because the GPSG framework has a semantic translation rule paired with a syntactic structure.

In chapter 3, it has become clear that the GPSG framework can solve semantic ambiguity with regard to a modal auxiliary and negation and that the grammaticality of the sentence can be accounted for with regard to an adverb and negation. This means that the GPSG framework is very effective in solving semantic problem.

4. CONCLUSION AND SOME PROBLEMS

In chapter 2, it is proved that the GPSG framework accounts explicitly for the complex facts of English auxiliary verb negation including VPD and SAI. In chapter 3, it is proved that the relative scope of modals and negation and that of adverbs and negation can be explained in an elegant way by adding some new scheme. Thus, GPSG has achieved good results in analyzing the complex linguistic phenomena. However, some problems are left unaccounted for.

(1) First of all, Gazdar et al. (1982;605) themselves point out that the GPSG framework cannot prevent several negations from showing up in one sentence. The following ungrammatical sentences will be produced by rule [14] and rule [15].

* (18) Kim won't have not been not going.

* (19) Kim mustn't not have not been not listening at that time.

(As for *n't*, Gazdar et al. (1982:598) assume that *n't* is not, synchronically, a reduced form of *not* but rather an inflectional suffix and appears only after $\begin{bmatrix}+\text{AUX}\\+\text{FIN}\end{bmatrix}$.) Ota (1980;458) says *not* can appear twice at maximum and one of them should appear after $\begin{bmatrix}+\text{AUX}\\+\text{FIN}\end{bmatrix}$. Therefore, some constraint will be necessary for the application of rule [14] and rule [15]. With regard to this, further study will be necessary.

(2) In this paper, English auxiliary verb negation is studied. However, in English *not* appears in many places except after auxiliary verbs.

(20) Not a man can be seen.

(21) He seems not being invited.

(22) She is not so unattractive a girl.

The above sentences are difficult to be generated by rule [14] and rule [15]. Higashimori (1984;135-136) says the above sentences can be generated by adding the following new rule schemata.

$[\overline{\overline{N}}\ (not)\ Det\ (\overline{\overline{A}})\ \overline{N}]$

$[\overline{\overline{N}}\ (\overline{\overline{N}})\ (not)\ \overline{V}]$
$[+GER]$

$[\overline{\overline{N}}\ Det\ (not)\ \overline{\overline{A}}\ N]$

According to the new rule schemata, sentence (20), (21) and (22) can be generated but the new rule schemata seems too descriptive. In addition to that, the semantic translation rules of them are not referred to. Generalization and further study will be necessary.

Though some problems are left unaccounted for, the GPSG framework has achieved good results in accounting for very subtle properties of linguistic structures. By strengthening the GPSG framework with some modification and extension, more linguistic phenomena in natural language can be accounted for. Further study in the GPSG framework will be expected.

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