Proceedings of the ESSLLI'05 Workshop on Empirical Challenges and Analytical Alternatives to Strict Compositionality

Heriot-Watt University
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Frank Richter and Manfred Sailer (Editors)

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Editors' Note

The workshop *Empirical Challenges and Analytical Alternatives to Strict Compositionality* was held from August 8th through 12th, 2005 as part of the *17th European Summer School in Logic, Language and Information (ESSLLI-2005)* at Heriot-Watt University in Edinburgh, Scotland.

We received twelve submissions, eight of which were selected for presentation at the workshop. Wilfrid Hodges accepted our invitation to appear as guest speaker.

The present proceedings volume features the full papers resulting from the successful submissions. They are arranged here according to the order in which they were presented at the workshop.

In the call for papers, we outlined the unifying theme of the workshop:

> *Compositionality has been a key methodological theme in natural language semantics. Recently, a number of innovative systems for combinatorial semantics have been proposed which seem not to obey compositionality at first sight. Such systems are based on unification, underspecification, linear logic, categorial grammar, variable free semantics, extensions of Montague Grammar, dynamic semantics, and Tree Adjoining Grammar, to name the most prominent research areas. The motivation behind these systems is often computational in nature, but the mechanisms they employ also provide new insights and analytical alternatives for outstanding problems in the combinatorial semantics of natural languages. These include scope ambiguities, multiple exponents of semantic operators, cohesion, ellipsis, coordination, and modifier attachment ambiguities.*
>
> *The workshop aims to bring together researchers whose interests lie in empirical issues or logic. We wish to invite papers discussing linguistic data which pose a challenge to compositionality as well as papers presenting new mechanisms for defining a compositional semantics which can address well-known challenges in innovative ways.*

The papers in this volume approach the overarching theme of compositionality from different theoretical angles, with varying methodological assumptions and on the basis of diverse data. We hope that they indeed offer a glimpse of the current state of discussion.

The programme committee consisted of Sigrid Beck, Gosse Bouma, Markus Egg, Howard Gregory, Fritz Hamm, James Higginbotham, Wilfrid Hodges, Pauline Jacobson, Theo M. V. Janssen, Graham Katz, Albert Ortmann, Gerald Penn, Adam Przepiórkowski, Mark Steedman, Henriëtte de Swart, Zoltán Szabó, and Thomas Ede Zimmermann. The editors would like to thank the workshop programme committee and the additional reviewer, Jakub Fast, for their contributions and thoughtful reviews. We would also like to express our thanks to Fairouz Kamareddine of the Local Organizing Committee for her responsiveness to all matters pertaining to

setting up the workshop in Edinburgh; and to Paul Dekker, Programme Committee Chair, for his ready assistance with everything having to do with the time line for organizing this workshop.

We are very grateful to Stefan Müller for his technical help in creating the workshop proceedings, and to Valia Kordoni for her initial advice in these matters.

Tübingen and Göttingen, May 2005

Frank Richter and Manfred Sailer

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Compositional semantics of an ambiguity associated with two types of focus constructions in French and in Japanese

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Abstract

French syntactic focus constructions and Japanese lexical ones involving a particle NANKA may indicate either that the focalized item is a representative member among a set of alternatives (exemplification meaning), or that, according to the speaker's prediction, the focalized item is not included among a set of alternatives (surprise meaning). This paper examines this intriguing ambiguity from compositionality perspectives.

It is argued that a pragmatic principle requiring that the informative value of a statement be maximal plays an important part in the derivation of the surprise meaning. Further, taking into account the presence or absence of a matrix existential clause in French cases and the internal composition of the particle NANKA including an existential or interrogative operator KA in Japanese cases, it is suggested that, if we adopte a view that the compositional computation of a sentence meaning may be effected after the interaction with pragmatics, both of the exemplification and surprise meanings may be derived compositionally.

1 Introduction

This paper deals with an ambiguity observed in two types of focus constructions: French syntactic focus constructions taking the form of NP + *qui (that)* + subordinate clause, illustrated in (1a) and (1b), and Japanese lexical focus constructions involving a focus particle NANKA, shown in (2a) and (2b). The NP + *qui*... construction in (1a), preceded by an existential matrix predicate *il y a (there's)*, indicates that the focalized item, *M. Michel*, is a representative member among a set of those who are dead. The same construction without a matrix clause in (1b), on the other hand, signals that the death of *M. Michel* is surprising and conflicting with the speaker's prediction:[1]

(1) a. Qui est mort? – Il y a Michel qui est mort.
'Who is dead? – There's Michel that is dead'

b. Ah! Mon dieu! dit-il, Monsieur Michel qui est mort!
'Oh, my God! said he, Mr. Michel that is dead!'
(Sandfeld, 1965, p.155)

[†]I want to thank Mme. Anne Zribi-Hertz and an anonymous reviewer for their severe and helpful comments on an earlier version of this paper. Responsibility of all errors and remaining problems rest on the author.

[1]The surprising meaning is discussed by some traditional grammarians: Sandfeld (1965, p.156) notes that 'most often, it [=the focus construction] marks a disagreement or contrast with a situation or a actual fact (le plus souvent, elle marque un désaccord ou contraste avec une situation ou un fait présent)'. According to Le Bidois and Le Bidois (1971, p.379), this construction expresses 'the strongly affective value of the sentence (surprise, regret, vivid opposition, etc.) (la valeur fortement affective de la phrase (étonnement, regret, vive opposition, etc.))'. These authors further argue that the NP *qui*...construction expressing surprise should be analyzed as an independent clause without being accompanied by any implicit matrix predicate.

(2) a. [Michel] nanka ga paatii ni yattekuru-daroo
M. Foc.Part. Nom party Loc come- Mod.
'Michel, for example, will come to the party'

b. [Michel] nanka ga paatii ni yattteki-ta
M. Foc.Part. Nom party Loc come-Pas
'It's surprising / inappropriate that MICHEL came to the party'
(adapted from Numata, 2000, p.195)

Similarly, in (2a), the item *Michel*, focalized by the particle NANKA, illustrates a member among a set of those who will come to the party. Numata (2000) calls this use "exemplification". The same item focalized by NANKA in (2b) is, within the speaker's perspective, a surprising or even an inappropriate member among a set of those who came to the party. This use is qualified by Numata (2000) "negative focus".

From compositional viewpoints, such an intriguing ambiguity raises a question how the same syntactic focus structure in French and the same focus particle in Japanese give birth to two seemingly unrelated meanings, and especially if the surprise meaning is compositionally derived.

In this paper, it will be argued that, if we assume with Han (2002) that compositional meanings may be computed after the interaction with the pragmatics, and adopting the possible world semantics which defines a proposition as a set of possible worlds, both of the exemplification and surprise meanings may be analyzed as derived in compositional ways.

The paper is organized as follows. Section 2 will represent in explicit semantic terms the ambiguity of French focus constructions so as to precise in what respects it is problematic for compositionality. Meanwhile, the surprising meaning will be compared with WH exclamation. Section 3 will present Han's analysis of rhetorical questions by way of a pragmatic principle requiring the maximal informative value of a statement. In Section 4, I will show that the maximal informative principle equally permits to make sense of the derivation of WH exclamation and surprise meaning. In Section 5, after examining the internal composition of the particle NANKA, I will propose to analyze the ambiguity of Japanese focus particle constructions in essentially the same way as that of French focus constructions.

2 Ambiguity associated with French focus constructions

2.1 Rooth's Alternative Semantics

In this section, I will ellucidate the contradictory nature of the above-mentioned ambiguity, with reference to French focus constructions. I first propose, adopting split CP projections, a syntactic representation in (3) for the NP + *qui*... construction in (1a,b):

(3) $[_{FocP}$ Michel$_k$ $[_{Foc}$ (Foc) $[_{CP}$ WH Op$_k$ $[_C$ that [t$_k$ is dead]]]].

(4) a. JOHNSON died. (Lambrecht, 1994, p.309) [surprise]
'Johnson qui est mort!'

b. JOHN arrived. (idem. p, 143) [existential]
'Y'a Jean qui est arrivé' (ibid.)

The focus analysis is supported by the fact that similar surprise and existential meanings are conveyed by phonological focus constructions in English, illustrated by (4a,b).

For the semantics of focus, I refer to Rooth's Alternative Semantics whose main idea consists of claiming that "evoking alternatives is the general function of focus" (Rooth, 1996, p.276). According to Alternative Semantics, a focus produces two semantic values, "ordinary semantic value" and "focus semantic value": the former boils down to a proposition including the focalized item, and the other corresponds to a set of alternative propositions where a variable is substituted for the focalized item. Thus, adopting Kadmon (2001)'s convincing remark that the focus should be defined intentionally in terms of possible world semantics, the ordinary semantic value and the focus semantic value for the examples (1a,b) are respectively represented by (5a) and (5b):

(5) a. $[[[\text{Michel}]_{Focus} \text{ is dead}]]^{ordinary} = [[\text{Michel is dead}]]^{M,g,w}$
$= \{\text{w: Dead (m)(w)}\}$

b. $[[[\text{Michel}]_F \text{ is dead}]]^{focus} = [[\text{WH Op}_k \text{ that x}_k \text{ is dead}]]^{M,g,w}$
$= \{\text{p: w}\in\text{p}\wedge\text{p}\in\text{C}\wedge\text{p} = \{\text{w: Dead (x)(w)}\}\}$

(5a) corresponds to the proposition "Michel is dead in w". For the focus semantic value, it should be noted that it doesn't consist of all the possible propositions, but is limited to contextually relevant ones, which are abbreviated by C in (5b). (5b) represents a set of contextually relevant propositions "x is dead in w" where the variable x is quantified by a WH operator syntactically activated in (3).

From this viewpoint, the semantics of exemplification in (1a) is represented by (6): (6) means that in a possible world (w), there exists, in the set of propositions depicted by the focus semantic value, a proposition corresponding to the ordinary semantic value, and in more intuitive terms, that the focalized item *Michel* is one of members among a set of dead persons:

(6) $[[\text{there's Michel WH Op}_k \text{ that x}_k \text{ is dead}]]^{M,g,w}$
$= \exists\text{p}\ (\text{w}\in\text{p}\wedge\text{p}\in\text{C}\wedge\text{p} = \{\text{w: Mort (x)(w)}\})\wedge\text{x=m})$

2.2 WH exclamatives

Next, in order to express the surprise meaning in (1b) within Alternative Semantics framework, I invoke an analysis of WH exclamatory clauses proposed by Zanuttini and Portner (2003). Inspired by an analysis of WH interrogatives as denoting a set

of true answers, these authors semantically define WH exclamatives, which equally include a WH item, as denoting a set of propositions. Thus, following the possible world semantics, the example in (7) is semantically represented by (7a):

(7) What things he eats!

a. [[what things he eats]]^{M,g,w}
=$\{$p: w$\in$p$\wedge\exists$x [p=$\{$w: Things (x)(w)$\wedge$Eat (he, x)(w)$\}$]
(adapted from Zanuttini and Portner, 2003, p.52)

b. w0$\in$p $\leftrightarrow$V $_{M,w0}$ [$\exists$x (Things (x)(w0)$\wedge$Eat (he, x)(w0))] = 1

c. [[he eats k]]^{M,g,w0}= 1

(8) a. I know how very tall Tony is. (idem. P.56)

b. *I don't know how very tall Tony is. (ibid.)

These authors also adopt a widely accepted view that exclamatives are factive, that is, presuppose the truth of the proposition in the actual world (w0). The WH exclamaitve in (7) thus presupposes, as shown in (7b), that the proposition "there exist things that he eats in w0" is true. If the entity that "he eats in w0" is signaled by a constant "k", the factive proposition in (7b) is paraphrased by the one "he eats k in w0" in (7c). The factivity of WH exclamatives is confirmed by their occurrence in the complement position of a factive matrix, as in (8a), and by their incompatibility with a non-factive matrix, like *don't know* in (8b).[2] To the question how the semantics of a set of propositions leads to the exclamatory meaning, Zanuttini and Portner propose an account in terms of "widening", characterized by (9a):

(9) a. 'the WH phrase binds a variable for which an appropriate value cannot be found in the contextually given domain. In order to find the appropriate value, one must look outside of the domain' (idem., p.50)

b. $\neg\exists$p (w$\neq$w0$\wedge$w$\in$p$\wedge$p$\in$D1$\wedge$p=$\{$w: Things (x)(w)$\wedge$Eat (he, x)(w)$\}\wedge$x=k)

According to this account, when stating an exclamation, the speaker presuppose an initial domain consisting of a set of contextually relevant propositions, and then looks for the one corresponding to the actual case. A WH item carries out this

[2]For the syntax of WH exclamatives, Zanuttini and Portner argue, based on Paduan exclamatives where a WH item co-occurs with a complementizer, that its two semantic features (denotation of a set of alternative propositions and factivity) are realized by two operators occurring in two distinct syntactic projections. The syntax of the example (7) is thus represented by (I), where a WH operator occurs in the specifier of the upper CP, while the specifier of the lower CP is occupied by a factive operator:

(I) [$_{CP1}$[what (WH) things]$_k$[$_{CP2}$FACT [$_{IP}$he eats t$_k$]]]
(adapted from Zanuttini and Portner, 2003, p.64)

scanning function. But after the scanning, the speaker cannot find an appropriate value, which he must widen the initial domain to find out. The exclamatory meaning is due to the speaker's confirmation that the actual case cannot be found in the initial domain.

I propose to represent the semantics of widening by (9b): (9b) indicates that, in a possible world (w) distinct from the actual world (w0) (i.e. the speaker's prediction), there exists no proposition corresponding to the factual one "he eats k" in a set of contextually relevant propositions (initial domaines) depicted by "he eats x".

2.3 Semantic representation of surprise meaning

The surprising meaning observed in (1b) may be analyzed in the same way. (1b) evokes the focus semantic value (a set of contextually relevant propositions) in (10a). The ordinary semantic value turns out to be factive, as shown in (10b). The factivity of French focus constructions without a matrix clause is supported by their incompatibility with negation or question of a matrix which leads to deny the truth of the complement, as illustrated by a contrast between (11a) and (11b,c):

(10) a. [[[Michel]$_F$ is dead]]^f= [[WH Op$_k$ that x$_k$ is dead]]^{M,g,w}
=$\{$p: w$\in$p$\wedge$p$\in$C$\wedge$p=$\{$w: Dead (x)(w)$\}\}$ [set of propositions]

b. [[[Michel]$_F$ is dead]]^0 = [[Michel est mort]]^{M,g,w0}
= $\{$w: Dead (m)(w0)$\}$ [factive proposition]

c . [[Michel WH Op$_k$ that x$_k$ is dead]]^{M,g,w}
= $\neg\exists$p (w$\neq$w0$\wedge$w$\in$p$\wedge$p$\in$C$\wedge$p =$\{$w: Mort (x)(w)$\}$)$\wedge$x=m) [surprise]

(11) a. Je vois Paul qui pleure. (adapted from Kleiber, 1988)
'I see Paul that is crying'

b. *Je ne vois pas Paul qui pleure. (ibid.)
'I don't see Paul that is crying'

c. *Est-ce que tu vois Paul qui pleure?
'Do you see Paul that is crying?'

The surprise meaning of (1b) is represented by (10c), parallel to the widening of WH exclamation. (10c) indicates that, according to the speaker's prediction (in a possible world w distinct from the actual world w0), there exists no proposition "Michel is dead " (ordinary semantic value) in a set of contextually relevant propositions "x is dead" (focus semantic value).

The propositions of this section are recapitulated as follows: a French focus construction indicates, with an existential matrix as in (1a), the inclusion of the ordinary semantic value in the focus semantic value (exemplification meaning), while it expresses, without a matrix like in (1b), the exclusion of the ordinary semantic value from the focus semantic value (surprise meaning). As shown above,

the exemplification meaning of French focus constructions is derived compositionally. The problem then is if the surprise meaning is also derived compositionally. In other words, it should be examined how the negative meaning in (10c) is derived from a set of proposition in (10a) and a true proposition in (10b). This question equally applies to the derivation of widening in (9b). I will try to bridge this derivational gap observed in exclamatory and surprise meanings, by taking into account Han's analysis of rhetorical questions, presented in next section.

3 Rhetorical questions

Just as WH exclamatives, a rhetorical question, superficially denoting a set of propositions, in fact expresses a negative proposition. Thus, a WH question involving a WH item *who* in (12a) literally denotes a set of propositions in (12b), and, when interpreted as a rhetorical one, expresses a negative proposition in (12c). The presence of a negation in rhetorical questions is confirmed by their compatibility with a strong negative polarity item, a, as shown in (13):

(12) a. Who finished the paper? (Han, 2002, p.217)

b. $[[\text{Who finished the paper?}]]^{M,g,w}$
=$\{$p:w∈p∧∃x [p=$\{$w: Person (x)(w)∧Finish-the-paper(x)(w)$\}$]

c. ¬∃p (w∈p∧∃x [p=$\{$w: Person (x)(w)∧ Finish-the paper (x)(w)$\}$])

(13) Who lifted a finger to help Mary? (Han, 2002, p.205)

Han (2002) accounts for how a set of propositions in (12b) is related to a negative meaning in (12c), by combining a semantic analysis of interrogatives and a pragmatic principle. This author first adopts the view that an interrogative denotes a set of *possible* answers. Thus, in a model M1 consisting of two members {Marie, Anne}, the possible values for the WH item *who* in (12a) is a power set of the set containing two individuals, that is, {ϕ, Marie, Anne, {Marie, Anne}}. The denotation of (12a) in M1 boils down to a set of four possible answers in (14):

(14) $[[\text{who finished the paper ?}]]^{M1,g,w}$
= {no one finished the paper in w, Marie finished the paper in w,
Anne finished the paper in w, Marie and Anne finished the paper in w}

The question raised by rhetorical questions therefore is reduced to explain why a negative answer is selected among possible ones.

Han resorts to a pragmatic principle dictating 'Make your contribution as informative as is required', according to which the information value of a statement should be maximal in a discourse. The most valuable information to the speaker is one contrary to his predication. Han further claims that, uttering a question, the speaker selects the form that would be the most informative if it is true, that is, the form the least compatible with his prediction. When uttering WH question in (12a), the speaker therefore predicts that there are in principle few persons who finished the paper. In a rhetorical reading, the intended answer by the speaker is the proposition which are the most compatible with his prediction, that is, a negative one.

What is interesting in Han's analysis from compositional viewpoints is that this author claims that "the LF output of a rhetorical *wh*-question interacts with pragmatics, and undergoes a post-LF derivation where the *wh*-phrase maps onto a negative quantifier "(Han, 2002, p.220). According to this analysis, after the WH item *who* in (12a) is replaced by the item *no one* at the post-LF level, the compositional interpretation of the whole sentence is effected. Consequently, although mediated by a pragmatic implicature, the semantics of WH rhetorical questions may be derived fully compositionally.

4 Derivation of exclamation and surprise meaning

4.1 WH exclamtives

Essentially the same account may apply to the derivation of the semantics of widening of WH exclamatives, but in slightly different ways. It was shown in section 2.2. that a WH exclamative in (15) denotes a set of contextually relevant propositions in (15a), and also presuppose a true proposition in (15b / c), and that this example in fact expresses a negative meaning, that is, the exclusion of the true proposition from a set of propositions, as shown in (15d):

(15) What things he eats!

a. $[[\text{what things he eats}]]^{M,g,w}$
=$\{$p: w∈p∧p∈D1∧∃x [p=$\{$w: Things (x)(w)∧Eat (he, x)(w)$\}$]

b. w0∈p ↔V $_{M,w0}$ [∃x (Things (x)(w0)∧Eat (he, x)(w0))] = 1

c. $[[\text{he eats k}]]^{M,g,w0}$= 1 (k is the value of x in w0)

d. ¬∃p (w≠w0∧w∈p∧p∈D1∧p=$\{$w: Things (x)(w)∧Eat (he, x)(w)$\}$∧x=k)

My proposal for the derivation of (15d) from (15a) and (15c) is as follows. Uttering the WH exclamative in (15) consists of using a form denoting a set of propositions in (15a) when a proposition is presupposed to be true in w0, as shown in (15c). The semantic interpretation of WH exclamatives are then effected by associating (15a) with (15c). Now, if the actual world (w0) would be included in a set of possible worlds (w), the true proposition in (15c) would turn out to be one member among the set of propositions in (15a). The association of (15a) with (15c) would then offer no valuable information to neither of them. This would violate the maximal informative principle.

In terms of this principle, the informative value of the conjunction of (15a) and (15c) will be maximal when a conversational implicature ia added so that a

possible world is different from the actual world, and that the true proposition in (15c) is true only in the actual world. This implicature boils down to indicate that in a possible world distinct from the actual world (the speaker's prediction), the proposition in (15c) is not true, which is exactly exclamatory meaning, depicted in (15d).

For example, suppose a model M2 involving a set of 3 entities {i, j, k}: they are further ordered on some scale (e.g. concerning strangeness as food) and the entity (k) is marked with the highest degree on the scale. In this model, the denotations of the three meanings in (15a), (15c) and (15d) are respectively illustrated in (16a), (16b) and (16c):

(16) a. {he eats i in w, he eats j in w, he eats k in w}
b. {he eats k in w0}=1
c. {he eats i in w, he eats j in w} (w≠w0)

If w0 were included in a set of possible worlds w, (16b) would be one member of (16a), and the association (16a) with (16b) would convey no valuable information to neither of them. Now conforming to the maximal informative principle, the informative value of the conjunction of (16a) and (16b) will be maximal when (16b) is true only in w0, that is, when, in a possible world w distinct from w0, the set of propositions in (16a) don't include the proposition in (16b), as illustrated in (16c).

It should be emphasized that, differently from the case of rhetorical questions, the semantic of widening is not due to the selection of a negative proposition among a set of propositions, but to the exclusion of the true one from the set of propositions. I therefore propose, modifying slightly Han's analysis of rhetorical questions, that the LF output of WH exclamatives interacts with pragmatics, and undergoes a post-LF derivation where a WH item maps onto a conditioned WH operator described by 'x other than the referent in the actual world'. Thus, at the post-LF level and before the computation of semantic meaning of the sentence, *what things* in (15) is replaced by "x other than k", as in (17):

(17) [[what things he eats]]^{M,g,w}
=[[he eats x other than k]]^{M,g,w} (w≠w0)

If this analysis is on the right track, we can say that the semantics of WH exclamation is derived compositionally.

The hypothesis that WH exclamatives involve, like rhetorical WH questions, a negation might be supported by the following observation. As shown by (13), rhetorical questions are compatible with a negative polarity minimalizer *a*. Zanutini and Portner (2003, p.50, footnote 15) suggest a possibility of analyzing an indefinite article observed in WH exclamatives like in "what a beautiful voice!" as the same type of negative polarity minimalizer. If so, the common compatibility with a negative polarity item may support a parallel treatment between rhetorical WH questions and WH exclamatives.

4.2 Surprise meaning of French focus constructions

I next propose to analyze the surprise meaning of French focus constructions as parallel to the widening of WH exclamatives. As claimed in section 2.3., the focus construction in (18) produces the focus semantic value, that is, a set of contextually relevant alternative propositions in (18a), and the ordinary semantic value which turns out to be true, as shown in (18b). And the surprise meaning is represented by (18c), which indicates that the ordinary semantic value is excluded from the focus semantic value in a possible world distinct from the actual world:

(18) Michel qui est mort!
'Michel that is dead! / MICHEL died!'
a. [[[Michel]$_F$ is dead]]^f= [[WH Op$_k$ that x$_k$ is dead]]^{M,g,w}
={p: w∈p∧p∈C∧p={w: Dead (x)(w)}} [set of propositions]
b. [[[Michel]$_F$ is dead]]^0 = [[Michel est mort]]^{M,g,w0}
= {w: Dead (m)(w0)} [true proposition]
c. [[Michel WH Op$_k$ that x$_k$ is dead]]^{M,g,w}
= ¬∃p (w≠w0∧w∈p∧p∈C∧p ={w: Mort (x)(w)})∧x=m)

In order to make sense of the derivation of the semantics in (18c), it should be compared with the case involving a matrix existential predicate, like in (1a). The function assumed by the existential predicate is to specify explicitely the inclusive relation between the focus semantic value and the ordinary semantic value. On the other hand, the absence of a main predicate in (18) leads to a situation where the set of alternative propositions "x is dead in w" and the true proposition "Michel is dead in w0" are related only pragmatically.

Conforming to the maximal informative principle, the conjunction of these two semantic values conveys the maximal information when the proposition "Michel is dead" is true only in the actual world, in other words, when the set of alternative propositions are restricted such as in a possible world distinct from the actual world, the variable x is different from the value *Michel*.

Adopting Han's view, we may argue that the LF output of French focus constructions without a matrix predicate interacts with pragmatics, and undergoes a post-LF derivation where the sequence "focus item + implicit WH operator" maps onto a restricted WH operator described by "x other than the focus item". Thus, at the post-LF level, the sequence "*Michel* + implicit WH operator" is replaced by "x other than Michel", as in (19):

(19) [[Michel WH Op that x is dead]]^{M,g,w}
= [x other than Michel is dead]]^{M,g,w}(w≠w0)

According to this analysis, the absence of a main predicate in French focus constructions substantially contributes to the derivation of their surprise meaning,

and therefore should not be restored by any syntactic or semantic process. This analysis is consonant with the claim advanced by some traditional grammarians that surprising focus constructions are truly independent clauses (see footnote 1).[3]

5 Ambiguity of Japanese focus particle constructions

In this section, I will show that the analysis proposed for the ambiguity of French syntactic focus constructions may apply in essentially the same way to Japanese lexical focus constructions with NANKA, illustrated by (2a) and (2b). Before treating the ambiguity associated with NANKA, I will examine the internal composition of this focus particle.

5.1 Internal composition of Focus particle NANKA

According to *Nihongo Daijiten (Grand Dictionary of Japanese)* 10 (2002, p.320), the focus particle NANKA stems from a contraction of the combination of I) a quantifiable item NANI which doesn't have its proper quantificational force and may be glossed by "thing (x)" (Nishigauchi, 1990), and of II) the operator KA. This operator is ambiguous, which is confirmed independently: it may be existential, as in (20a), or interrogative, as in (20b):

(20) a. Michel wa nani- ka o tabe- ta.
M. Top thing(x) -OP$_{exist}$ Acc eat- Pas
'Michel ate something'

b. Michel wa nani o tabe- ta no ka ?
M. Top thing(x)-Acc eat- Pas Comp OP$_{interrogative}$
'What did Michel eat ?'

The combination of NANI and of KA boils down to an existentially quantified referent paraphrased by "something" in the former case, and to a WH item paraphrased by "what" in the latter.

I advance an idea that the ambiguity of the particle NANKA is reduced to the ambiguous fonction of the operator KA: KA is existential in the exemplification use, and interrogative in the negative focus use. In what follows, I will show that this hypothesis may make sense of the derivation of the two meanings expressed by NANKA constructions.

[3] Stainton (2004) recently defends an idea that a syntactic or semantic ellipsis is not always required for the interpretation of non-sentential speeches, like 'Sam's mom' (uttered in a situation where both the speaker and the hearer are looking at the referred woman in the doorway), and suggests that the gap between a literal meaning (i.e. entity) and the intended meaning (i.e. proposition) of such one-word sentences is bridged via the inferential process treating perceptual information and extra-linguistic knowledge. My claim concerning the French focus construction in (18) is that the inferential process mentioned by Stainton is irrelevant for its surprise meaning which arises not via such an inference process, but by way of a conversational implicature.

5.2 Exemplification use

The focus construction involving NANKA in (21) produces, as usual, the ordinary semantic value in (21a) and the focus semantic value in (21b):

(21) [Michel] nanka ga paatii ni yattekuru-daroo (=(2a))
M. Foc.Part. Nom party Loc come- Mod.
'Michel, for example, will come to the party'

a. $[[[\text{Michel}]_F \text{ will come to the party}]]^o$
$=\{w: \text{Will-come-to-the-party (m)(w)}\}$

b. $[[[\text{Michel}]_F \text{ will come to the party}]]^f$
$=\{p: w\in p \wedge p\in C \wedge p=\{w: \text{Will-come-to-the-party (x)(w)}\}\}$

c. $\{p: w\in p \wedge p\in C \wedge p=\{w: \exists x \text{ (Will-come-to-the-party (x)(w))}\}\}$

d. $[[\text{Michel-NANKA will come}]]^{M,g,w}$
$=\exists p\ (w\in p \wedge p\in C \wedge p =\{w: \text{Will-come-to-the party (x)(w)}\}) \wedge x=m)$

When the operator KA is existential, it binds the entity variable included in the focus semantic value. The focus semantic value in (21b) then boils down to a set of restricted propositions depicted by "someone will come to the party in w", as shown in (21c). The association of (21c) with the proposition "Michel will come to the party in w" in (21a) leads to the exemplification meaning "Michel is one of those who will come in w", as formalized in (21d).

5.3 Negative focus use

When the operator KA is interrogative, NANKA consists of a quantifiable item and an interrogative operator binding it. The association of them boils down to a WH interrogative operator, just as in the case of (20b). The focus semantic value of the negative focus use in (22) therefore remains the same after the compositional interpretation of NANKA is effected, and corresponds to a set of alternative propositions, as shown in (22a):

(22) [Michel] nanka ga paatii ni yattteki-ta (=(2b))
M. Foc.Part. Nom party Loc come-Pas

a. $[[[\text{Michel}]_F \text{ came to the party}]]^f$
$=[[\text{NANKA (WH Op) came to the party}]]^{M,g,w}$
$=\{p: w\in p \wedge p\in C \wedge p=\{w: \text{Came-to-the-party (x)(w)}\}\}$

b. $[[[\text{Michel}]_{Focus} \text{ came to the party}]]^o$
$= [[\text{Michel came to the party}]]^{M,g,w0}$
$=\{w: \text{Came-to-the-party (m)(w0)}\}=1$

The ordinary semantic value is factive, as shown in (22b). The factivity of this case is supported by the fact that the whole sentence may be embedded under the sequence TO (complementizer of quotation) + WA (topic), and that a clause involving the sequence TO-WA is naturally understood as predicated by a factive predicate like *odorokida* "be surprising, as in (23):

(23) [Michel nanka ga yatteki-ta] to wa (odorokida)!
[M. Foc.Part. Nom come-Pas] Comp Top (be surprising)
'That MICHEL came (is surprising)!'

Consequently, just as French syntactic focus constructions without a matrix predicate, the Japanese focus particle construction in (22) is reduced to the conjunction of a set of alternative propositions "x came to the party in w" in (22a) and a true proposition "Michel came to the party in w0" in (22b). Conforming to the maximal informative principle, the informative value of this conjunction is maximal when a conversational implicature is added according to which, in a possible world distinct from the actual world, the variable (x) is different from the focalized item *Michel*.

Following Han's view, wa can say that the LF output of the French surprise focus construction in (22) interacts with pragmatics, and undergoes a post-LF derivation where the sequence "*Michel* + NANKA (WH operator)" maps onto a restricted WH operator described by "x other than Michel", as represented in (24):

(24) $[[[\underline{\text{Michel-NANKA (WH Op)}}$ came to the party$]]^{M,g,w}$
$= \neg\exists p\,(w{\neq}w0 \wedge w{\in}p \wedge p{\in}C \wedge p = \{w\text{: Came-to-the-party }(x)(w)\}) \wedge x{=}m)$
$= [\underline{\text{x other than Michel}}$ came to the party$]]^{M,g,w}(w{\neq}w0)$

Such a parallel treatment between NANKA constructions and rhetorical questions may be supported by the existence in many languages (French, German, etc.) of a kind of special rhetorical question, illustrated by (25a,b):

(25) a. Que tardez-vous ?! (Munaro and Obenauer 2002) [French]
what are-late you
'Why are you (so) long (doing) it?!'
b. Was schaust du mich so an ?! (idem.) [German]
what look you at-me so
'Why are you looking at me like that?!'

This construction expresses "the speaker's surprise, annoyance or disapproval with respect the event referred to" (Munaro and Obenauer, 2002): (25a) conveys "the speaker's surprise or perplexity, his failure to see the reasons" why the hearer is looking at him in the actual manner. This construction thus indicates that the

actual situation is inappropriate from the speaker's viewpoint, strikingly similarly to the negative focus use of Japanese NANKA constructions.

Munaro and Obenauer observe that a formal particularity of this construction is to involve a WH item corresponding to English *what*, but interpreted as *why* in a non-argumental position: in the above examples, all the argument slots (e.g. subject in (25a) and subject and direct object in (25b)) are occupied. These authors suggest that the origin of such a special use of *what-like* WH item may be traced to its lexically poorer and underspecified features: while some feature is positively specified for other WH items like *who* [+human], *where* [+place], *why* [+reason], etc., those of *what-like* WH items are only negatively speficied, such as [-human], [-place], [-place], etc.

Such a semantic underspecification is also observed in the focus particle NANKA. As mentioned in 5.1., NAN(I) of NANKA may be glossed by "thing (x)". NAN(I) in uses other than focus particle is restricted to denote a [-human] and [-place] referent, just as *what-like* WH item. The focus particle NANKA however may be attached to a [+human] item, as in (22), or even to a [+place] item, as in (26):

(26) kimi ga Tokyo ni nanka iku-to-wa (odorokida)
you Nom Tokyo Loc NANKA go-Comp-Top (be surprising)
'That you go to TOKYO is surprising'
'How come you go to Tokyo?'

Such an underspecification of features commonly observed in NANKA and a *what-like* WH item in surprise rhetorical questions seems to justify a parallel treatment of them.

6 Conclusion

This paper examined an intriguing ambiguity observed in French syntactic focus constructions and Japanese lexical ones with a particle NANKA, between an exemplification meaning and a surprise meaning: the former indicates that the focalized item is a representative member among a set of alternatives, while the latter signals that, according to the speaker's prediction, the focalized item is not included among a set of alternatives.

The focus was first defined, following Alternative Semantics, as producing the ordinary semantic value (a proposition including the focalized item) and the focus semantic value (a set of alternative propositions involving a variable). Then, taking into account the presence or absence of a matrix predicate in French constructions, and the internal composition of the particle NANKA involving an existential or interrogative operator KA for Japanese cases, the following derivations were proposed for the exemplification and surprise meanings.

In French syntactic focus constructions, the exemplification meaning is due to a matrix existential predicate, which serves to indicate that the ordinary semantic

value (a proposition) exists among the focus semantic value (a set of alternative propositions). In Japanese lexical ones, such an existential function may be assumed by an existential operator KA included in the particle NANKA.

When the surprise meaning is observed, French focus constructions lack a matrix predicate: in Japanese ones, the particle NANKA may be interpreted as a WH operator, compositionally formed by NAN (quantifiable item) + KA (interrogative operator). And in both cases, the ordinary semantic value turns out to be factive, that is, true in the actual world. Next, either because of the absence of a matrix predicate or by way of WH operator, the ordinary and focus semantic values are associated only pragmatically. The maximal informative principle then gives birth to a pragmatic implicature according to which the proposition depicted by the ordinary semantic value is true only in the actual world. This implicature boils down to restrict the focus semantic value so that, in a possible world distinct from the actual world, the variable involved in the set of alternative propositions is different from the focalized item.

It was furthermore suggested that, if we adopt with Han (2002) that the compositional computation of a sentence meaning may be effected after the interaction with pragmatics, the surprise meaning is derived, as well as the exemplification meaning, in compositional ways.

References

Han, Chung-hye. 2002. Interpreting interrogatives as rhetorical questions, *Lingua* 112, 201-229.

Kadmon, Nirit. 2001. *Formal pragmatics*, Blackwell.

Kleiber, Georges. 1988. Sur les relatives de type *Je le vois qui arrive*, *Travaux de Linguistique* 17. 89-115.

Lambrecht, Knud. 1994, *Information Structure and Sentence Forms*, Cambridge Univ. Press.

Le Bidois, Georges. and Le Bidois, Robert. 1971. *Syntaxe du français moderne, ses fondements histriques et psychologiques*, tome 2. Picard.

Munaro, Nicola. and Obenauer, Hans-Georg. 2002. On the semantic widening of underspecified *wh*-elements, In Manuel Leonetti, Olga Fernandez Soriano and Victoria Escandell Vidal (eds.), *Current Issues in Generative Grammar*, Universidad de Alcala / UNED / Universidad Autonoma de Madrid.

Nihongo daijiten (Grand dictionary of Japanese), 2003, vol.10, second edition. Shogakukan, Japan.

Nishigauchi, Taisuke. 1990. *Quantification in the theory of grammar*, Kluwer.

Numata, Yoshiko. 2000. Toritate (focus particles), In Satoshi Kinsui, Mayumi Kudo and Yoshiko Numata (eds.), *Toki, hitee to toritate (Tense, negation and focus particles)*, Iwanami Publishers, Tokyo: Japan. 153-216.

Rooth, Math. 1996. Focus, In Shalom Lappin (eds.) *The handbook of contemporary semantic theory*, Blackwell, 271-297.

Sandfeld, Knud. 1965. *Syntaxe du français contemporain 2: Les propositions subordonnées*, Droz.

Stainton, Robert J. 2004. The pragmatics of non-sentences, In Laurence R. Horn and Gregory Ward (eds.), *The handbook of pragmatics*, Blackwell, 266-287.

Zanutini, Raffaella. and Portner, Paul. 2003. Exclamative Clauses: at the Syntax-Semantics Interface, *Language* 79(1), 39-81.

The normality of 'metalinguistic' foci: a challenge to strict compositionality

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Abstract

Under conventional assumptions of strict compositionality, focus must be treated as a semantic phenomenon that is directly encoded in the grammars of human languages. This is because it can be shown to affect the truth conditions conveyed by an utterance. I show that semantic theories of focus are incapable of dealing with a range of examples which, though they might be termed 'metalinguistic', show all the key characteristics of focus and therefore should be explained by any suitably general analysis of it. As such, focus provides evidence against the assumption of compositionality itself: quite simply, this assumption leads to unsustainable analyses. I argue that this is both predictable and unproblematic, since a coherent view of linguistic theory from a broader perspective demands a role for inferential pragmatics that is incompatible with traditional notion of strict compositionality.

1 Introduction

Under strict assumptions of compositionality, focus (as indicated by certain kinds of pitch accent in English) must be given a compositional semantic analysis, because it can demonstrably affect the truth conditions of a sentence, as shown in the textbook 'association with focus' examples (1) and (2) (where the location of focus is indicated by SMALL CAPS).

(1) a. John only introduced BILL to Sue.
b. John only introduced Bill to SUE.

(2) a. In St Petersburg, OFFICERS always escorted ballerinas.
b. In St Petersburg, officers always escorted BALLERINAS.

In this paper I argue that other examples of the behaviour of focus undermine the assumption that fully compositional encoding follows from the ability to affect truth conditions. In particular, many so-called 'metalinguistic' uses of focus show all the distinctive characteristics of focus, including compatibility with 'association with focus' phenomena, but resist any kind of straightforward compositional analysis. Rather, they demand the introduction of material that is determined by extra-linguistic pragmatic processes of 'enrichment', as envisioned in post-Gricean pragmatic approaches such as Relevance Theory (Sperber and Wilson, 1986). As such, the broader phenomenon of focus represents a challenge to assumptions of strict compositionality: under such assumptions, focus would have to be interpreted by deterministic semantic rules, but there exist recognisable, in most ways quite canonical, examples of focus which show this to be impossible.

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1.1 Sub-constituent and other unconventional foci

The vast majority of literature on focus deals in examples like (1) and (2) where focus is assumed to fall on a single lexeme, or examples like (3), where larger constituent is assumed to be in focus (in this case, VP; note that the indication of the location of focus here is not meant to reflect phonological facts directly, since some form of focus projection from a single pitch accent is usually assumed in such cases).

(3) John only WENT TO THE SHOPS [i.e. he didn't run away from home / he didn't do his homework]

Such examples are on the whole amenable to a compositional semantic analysis, since the presumed meaning of a word or larger syntactic constituent can be abstracted from the sentence and some operation can be applied to this to produce the focus-affected meaning. Typically, this operation involves reference at one level or another to a set of contextually licensed alternatives to the denotation of the focused constituent. This reflects the intuitive evocation of alternative 'fillers' of the slot vacated by a focused item when it is abstracted away from the 'background' part of the sentence. Such sets of alternatives provide a means to pin down the contribution of focus in model-theoretic terms and thereby to maintain a compositional analysis of focus. Perhaps the best known of such approaches is Rooth's (1985; 1992; 1996) 'alternative semantics', which I very briefly outline below (however, my arguments in this article do not concern Rooth's approach specifically, but rather the very idea of treating focus effects by mechanistic semantic operations).

Whether or not this kind of approach is entirely adequate for basic examples of focus on conventional constituents is debatable (see, for example, von Heusinger, 2004), but the examples that I concentrate on here are of a different kind. Focus can also operate below the word level and, significantly, can affect aspects of meaning that are not normally dealt with by model-theoretic semantics. Artstein (2002b, 2004) addresses certain kinds of focus below the word level, such as (4).

(4) Kim found a stalagMITE.

Here the focal pitch accent falls on a syllable that is not the normal location of lexical stress and the interpretation is correspondingly unusual: instead of implying contrast with any contextually licensed alternatives to the denotation of *stalagmite*, the contrast drawn is clearly restricted to two similar-sounding words: *stalagmite* versus *stalactite*. Nevertheless, in every other way this looks like a standard use of focus and the kind of interpretation that one would expect from it. Artstein's response (as outlined below) is to propose an extension to standard model-theoretic semantics that gives denotations to focused parts of words and therefore allows these cases to be dealt with within a theory like Rooth's.

Artstein's approach is laudable in that it does not shy away from probing such 'peripheral' examples, which, though easily ignored, are potentially problematic

for standard approaches and undoubtedly require explanation if such approaches are to be upheld. However, I believe that Artstein's examples only scratch the surface of a deeper problem. There are other uses of focus, both below and at the word level, that clearly involve meanings that defy conventional relationships between syntactic constituency and model-theoretic semantics, and these cases cannot be dealt with by simply introducing new kinds of denotation. Instead, they seem to call for an inferential pragmatic analysis; one which presupposes a view of relationship between semantics and pragmatics that is straightforwardly incompatible with strict compositionality.

The kind of examples I have in mind are illustrated in (5)[1]:

(5) a. That wasn't a steak. It wasn't even a MIstake—it was more of a crime against cookery.

b. Q. Would you like some tom[eɪɾoʊz]?
A. Sorry, I only eat tom[a:toʊz].

c. Q. Have you ever seen a STALagmite?
A. No. I've been into many caves, but I've only ever seen staLAGmites.

d. Q. Do you really eat rutabaga at Burns suppers?
A. We only eat NEEPS.

These examples have a distinctly 'metalinguistic' flavour, (5b–d) even being based in minor dialectal differences[2]. Some analysts might therefore be content to assume that they represent a quite distinct phenomenon to the normal use of focus. I do not find this response to be adequate, as the form of such examples is essentially the same as that of any other use of focus, while the interpretation produced also shares crucial characteristics with recognised cases of focusing (as I argue in section 3 below).

What the interpretation of the examples in (5) also seems to require is the enrichment of the linguistically encoded meaning of the respective utterances to introduce material derived from processes of pragmatic inference. For example, the intuitive meanings of (5a,b) may be rendered roughly as in (6), where pragmatically interpolated material is italicised.

(6) a. That wasn't *something that could reasonably be called* a steak. It wasn't even *something that could reasonably be called* a MIstake—it was more of a crime against cookery.

b. Q. Would you like some tom[eɪɾoʊz]?
A. Sorry, *I do not recognise the existence of something of that name, so where the relevant vegetable is concerned* I only *recognise that I* eat tom[a:toʊz].

[1] (5b) is due to Noh (2000).

[2] The different pronunciations of *tomato* are well known, but readers may or not be aware that British and American English stress the word *stalagmite* differently (the word-initial stress is the standard British version). *Neeps* is the Scots word for the vegetable known as *rutabaga* in American English and *swede* in England (*brassica napobrassica*).

As these paraphrases show, this process of enrichment must be a rather free one, in order to produce the precise readings of the full range of potential examples of this kind. It is plainly a non-compositional process. A compositional semantic theory of focus therefore fails to explain the part that focus plays in such cases. The question then arises as to whether focus as a whole could reasonably be seen as something rather more underspecified, in fact quite regularly involving pragmatic inference, such that a single basic interpretation of focus underlies all of the examples in (1)–(5). I believe that this is both possible and desirable, for reasons outlined in section 5. Thus, the kind of analysis required for (5a–d) generalises to the full range of examples, while the compositional approach does not. In essence, focus is a phenomenon that demands the kind of 'post-Gricean' analysis advocated in Relevance Theory (Sperber and Wilson, 1986; Carston, 2002), whereby truth-conditional meaning is regularly influenced by general pragmatic reasoning, hence not necessarily derived directly by compositional means. Focus interpretation provides evidence for this view, since it demonstrably can affect truth conditions but no directly encoded semantic mechanism can account for some of its uses, which are however explained by pragmatic enrichment processes.

2 'Focus semantics' and parts of words

As noted above, a crucial part of my argument must be to provide justification for the claim that 'metalinguistic' examples like those in (5) are true cases of focus, of a kind that any adequate analysis of the phenomenon should deal with. Before doing so, it is instructive to review Artstein's (2004) observations regarding his examples of focus on parts of words and his proposals for dealing with such examples. After all, Artstein too has to justify his application of standard theories of focus to sub-word cases, while my position rests on the argument that similar examples exist which neither Artstein's proposals not anything like them could explain.

Artstein (2004, 3) notes that most treatments of focus interpretation have either ignored the issue of sub-word foci or have dismissed it as a 'metalinguistic' phenomenon (with the implicit assumption that regular semantic processes need not be consistent with metalinguistic interpretations)[3]. As such, there has been a general failure to explain focus below the word level in terms of the mechanisms proposed to deal with focus in general. Artstein points out that this seems quite unjustified by the data: focus on parts of words shows all the defining characteristics of focus as it applies to words or phrases.

[3]The applicability of the term 'metalinguistic' is debatable here, whatever ones theoretical position. Artstein (pc.) has suggested that examples like (4) are not obviously metalinguistic in the way that, say, Horn's (1989) 'metalinguistic [i.e. non-logical] negation' is and there is arguably some sense in which (5a–d) feel 'more metalinguistic' than (4). On the other hand, (4) does invite a contrast between two words purely on the basis of their similarity of form (and only via this invites the contrast of their meanings) and it arguably involves an 'echoic' use of language. However, since I argue that all foci should be dealt with by one theory of focus, whether metalinguistic or not by any given definition, the terminological issue is in effect immaterial to my concerns.

First, cases of sub-word focus like (4) plainly involve not just the phonological prominence associated with focus but also key parts of its interpretation, such as the involvement of contrast, as indicated in (7). The interpretation of (7) involves contrast with a salient alternative just as much as does the interpretation of (8), even if it happens to be the case that (7) has something to do with the phonological similarity the word involved to an alternative word, while (8) more directly contrasts semantic entities.

(7) Kim found a stalagMITE [i.e. not a stalactite].

(8) John introduced BILL to Sue. [i.e. he didn't introduce, e.g., Norman to Sue, as you may have been thinking]

Moreover, the very processes that are most commonly used to motivate semantic theories of focus, and which tend to determine their form, demonstrably apply to sub-word foci as well as to focused words and phrases. Specifically, the phenomenon of 'association with focus' manifested by expressions like *only* and *even* (and many others) can occur with sub-word foci, with quite predictable effects. If a semantic account of focus is considered necessary in order to account for the textbook 'association with focus' examples in (1), repeated here as (9), it must surely be operative also in (10). It is clear that each case requires an entirely parallel explanation of how the scope of *only* is determined by the location of phonological prominence.

(9) a. John only introduced BILL to Sue.
b. John only introduced Bill to SUE.

(10) a. Sandy only met a MILLionaire [only possible contrasts: Sandy met a billionaire, zillionaire . . .].
b. Sandy only met a millionAIRE. [possible contrasts include: Sandy met the richest man in the world, the Prime Minister, a lifelong role-model . . .].

Such examples illustrate Artstein's point that any interpretive mechanism that is proposed to account for the likes of (8) and (9) must also be capable of accounting for sub-word examples like (7) and (10). Artstein's own response to this situation is to assume that some form of model-theoretic semantics must be defined for parts of words, so that existing notions of 'focus semantics' can be applied directly to them. He proceeds to develop such a semantics of word parts; continuing to develop my arguments in the light of Artstein's, I summarise this and offer some criticisms of it below. This necessitates a brief review of Rooth's alternative semantics, in terms of which Artstein's presents his proposals.

It is important to stress that my aim is not simply to take issue with Artstein's or Rooth's particular proposals. Artstein's extension of Rooth's approach constitutes

a reasonable and in certain key ways inevitable response to the examples above, within the paradigm of 'focus semantics'. It is this paradigm that is at fault; where these particular proposals fall down, so will any attempt to extend focus semantics to the analysis of sub-lexical foci.

2.1 Alternative semantics

Rooth's approach is a compositional semantic theory of focus insofar as it aims to account for the interpretive differences caused by differing locations of focus via a rule-based mechanism, which manipulates model-theoretic semantic forms. Rooth invokes pragmatics to do the job of determining the precise alternative set that is referred to in a focus-affected interpretation, but this in effect merely restricts the domain of any focus-sensitive operator. Crucially, this pragmatic process is tightly constrained by semantic representations which derive directly from the natural language string. In essence, then, the approach is a conventional compositional semantic one, in the sense that the shape of the eventual semantic representation is determined purely by the decoded meaning of the natural language string (including its prosody), with only the values of some indexical elements left to context-sensitive pragmatic processes.

More specifically, Rooth's alternative semantics works as follows. Focus-sensitive operators make reference in their lexical semantics to an alternative set C—for example, *only* might be defined as in (11) (see Rooth 1996; p and q have the type of propositions and p is the proposition expressed by the sentence at hand, minus the effects of focus and *only* itself):

(11) $\lambda C\, \lambda p\, \forall q[q \in C \wedge {}^{\vee}q \leftrightarrow q = p]$
('Everything that is a true proposition in the set C is the proposition p.')

The actual content of the alternative set C is restricted by the 'focus interpretation operator', $\sim$, whose effect is to introduce two presuppositions: (i) C is a subset of the 'focus semantic value (FSV) of the sentence and (ii) C contains the 'ordinary semantic value' of the sentence and at least one other item. The FSV of a sentence ϕ, written $[\![\phi]\!]^f$, is a set of formulae derived by abstracting over the focused part of the sentence, as in (12a), while the ordinary semantic value, written $[\![\phi]\!]^o$, is the semantics of an expression if focus and any focus-sensitive operators are ignored, as in (12b).

(12) a. $[\![$ [Bill]$_F$ wants coffee $]\!]^f$ =
the set of propositions of the form "x wants coffee"

b. $[\![$ [Bill]$_F$ wants coffee $]\!]^o$ =
the proposition 'Bill wants coffee'.

The role of pragmatic processes performed in context is therefore limited to saturating the tightly constrained set-type indexical C; it remains the job of purely

semantic rules to determine what *kind* of alternative set will be constructed and thereby to determine how the location of focus affects the truth-conditions. Furthermore, the output of these rules, and input to the indexical-saturating pragmatic processes, is a set of strictly model-theoretic representations.

2.2 Denotations for arbitrary word parts

Recall that Artstein's aim is to integrate examples like (4) into a semantic approach to focus, such as Rooth's. To do this requires two things:

(13)
- a way of assigning denotations of some kind to arbitrary parts of words
- a way of relating such denotations back to the denotations of full words and other expressions, to integrate sub-word foci into a compositional system and create appropriate alternative sets

To achieve the first of these, Artstein proposes a process of 'phonological decomposition'. This involves the assumption that a part of a word can "denote its own sound" when focused[4]. To achieve the second, he gives the unfocused remainder of the word (e.g. *stalag-*) the semantics of a function from sounds to word meanings. More specifically:

(14) Let A be the unfocused part of a word, and let τ be the type of the whole word. Then $[\![A]\!]^o \in \mathrm{D}_{e\tau}$ is the function $h : \mathrm{D}_e \rightarrow \mathrm{D}_\tau$ such that for all $\beta \in \mathrm{D}_e$, $h(\beta) = [\![A\beta]\!]^o$ if $A\beta$ is a word and $[\![A\beta]\!]^o \in \mathrm{D}_\tau$, undefined otherwise.
(Artstein, 2004, 8)

Treating the unfocused parts of the relevant words in this way allows Artstein to produce appropriate FSVs in cases of sub-word focus: given (14), "the focus semantic value of a word with a focused part comes out to be the set of denotations (matching in type) of words that share the unfocused phonological material" (Artstein, 2004, 9). For example, abstracting over *-mite* in *stalagmite* leaves *stalag-*, which in effect denotes a function whose only possible outputs are $[\![$*stalagmite*$]\!]$ and $[\![$*stalactite*$]\!]$ (Artstein notes that the system must tolerate certain differences at the peripheries of word parts, such as the voiced/voiceless difference found in the final consonant of the 'shared' part of these words in most dialects). Intuitively,

[4] Artstein presents other motivations for this process, including the use of word parts in coordination of (e.g. *ortho- and periodontists*) and echo questions (*Bill is a what-dontist?*) (see Artstein, 2002a,b, to appear). I limit my arguments here to the issue of focus; nothing in this article rules out the possibility that a 'phonological decomposition' analysis is appropriate for other phenomena, which would have to be looked at in their own terms (although the particular case of echo questions clearly involves interaction with focusing).

this is precisely the alternative set required in the interpretation of a sentence containing the sub-word focus *stalag*MITE[5]. For example, given the semantics of *only* as shown in (11), the information conveyed by the sentence *Kim only found a stalag*MITE can only be that Kim found a stalagmite and did not find a stalactite.

This illustration shows how Artstein's approach enables focus semantics to be extended to sub-word cases just because it mechanistically provides extensional denotations for arbitrary word parts. A theory that does just this is quite necessary to sustain a semantic account of focus in the face of data like (10), whether or not Artstein's particular operation of phonological decomposition is adopted. Given this necessity, Artstein's proposals would seem as sensible as any, but my argument goes beyond this: *no* approach can successfully provide a determinate model-theoretic denotation that will account correctly for every instance of sub-word focus, still less for every case of 'metalinguistic' focus. In the following sections, I address my criticisms to Artstein's proposals, as the only properly formulated proposals of their kind; however, it should be borne in mind that the source of the shortcomings that I highlight lies in the fundamental nature of the problem that Artstein addresses and not in the details of his ideas.

2.3 Sounds as denotations and levels of meaning

One potential question mark over Artstein's proposals is the sheer plausibility of his 'sound denotations'. Though perhaps initially surprising, the idea of linguistic items denoting their own phonetic forms in a model need not be considered too outlandish. Given the very fact that language users can contrast potential completions of word forms with each other, it is clear that arbitrary parts of words can be conceptualised as being entities in some sense. From this point of view, including phonetic forms as denotations in a model need not be considered any stranger than, say, invoking possible worlds. Nevertheless, there perhaps remains a certain intuition that the process of contrasting sounds in some way occurs at a different level to the implicit contrast of more traditionally accepted elements of 'meaning'—hence the strategy of some previous analysts, albeit an inadequate one, of labelling sub-word contrasts 'metalinguistic'.

As will become clear below, my preferred strategy of replacing 'focus semantics' with a more heavily pragmatic form of analysis removes this concern: under such an analysis there is a consistent and predictable relationship between the use of focus and the evocation of alternatives, but the kinds of objects treated as alternatives may naturally be of quite different kinds. That is, within an analysis that doesn't require alternative sets to be defined in terms of pure denotations, there is considerable scope for more complex kinds of alternatives to emerge, as a result of

[5]Note that Rooth's $\sim$ operator would apply redundantly in this case. The above discussion assumes the American English realisation of *stalagmite*; In British English, where stress normally falls on the initial syllable of this word, one should probably also introduce a proposition containing a word like *stalagluft* into the FSV, according to Artstein's rules, though this would never become part of the the actual alternative set C in any conceivable context.

the interaction of encoded meaning with interlocutors' assumptions and communicative intentions. In this case, it is predictable that the implicit contrasts drawn by certain uses of focus will have a particular rhetorical flavour (whether we choose to call this 'metalinguistic' or not); under a denotational analysis like Artstein's, this intuition remains unexplained. This is plainly not a particularly substantial argument against Artstein's proposals, however. More significant problems reside in the process of integrating Artstein's 'sound denotations' with the rest of the sentence—that is, in the process of the composition of meaning.

This brings us back to the kind of examples introduced in (5). Before discussing the nature of the problems they cause for any semantic approach to focus interpretation, it is necessary to argue the case for treating these on a par with Artstein's examples of focus on word parts and more generally the case for expecting any semantic theory of focus, such as the Rooth/Artstein approach, to deal with them. This is the business of the following section.

3 What counts as focus

Examples like (5a,b), repeated here as (15a,b), share significant characteristics with more 'canonical' uses of focus (such as those in (1) and (2)) and in particular with Artstein's sub-word examples.

(15) a. That wasn't a steak. It wasn't even a MIstake—it was more of a crime against cookery.

b. Q. Would you like some tom[eɪɾoʊz]?
A. Sorry, I only eat tom[a:toʊz].

Many of the arguments used by Artstein to show that a theory of focus must deal with focusing of word parts carry over directly to these examples. Most obviously, they involve the use of phonological prominence to signal some particular interpretive effect. This effect is notably one that is at the core of more standard examples of focus: contrast drawn between the accented item and some contextually available alternative. This much on its own seems to me to justify designating an example as an example of focus; it is precisely this relationship between phonological prominence and this kind of interpretive effect that *defines* focus and it is the very purpose of semantic theories of focus to capture this relationship, as is made clear in the following description of the methodology of focus semantics:

> We somehow modify our way of modeling the semantics of phrases so that phrases differing in the location of focus have different semantic values. We then state semantic and pragmatic rules for focus-sensitive constructions and discourse configurations in terms of such focus-influenced semantic values. (Rooth, 1996, 275)

Furthermore, (15a,b) show the key property of compatibility with 'association with focus' operators like *only* and *even*. We expect these items to relate to focus in a certain way and to have a certain effect on meaning. If we were to argue that examples like (15a,b) are not interpreted according to the usual mechanisms of focus interpretation, then we would presumably have to assume that *only* and *even* play different roles in the composition of meaning here, thereby in effect committing ourselves to the idea that they are ambiguous. This seems a decidedly undesirable outcome; intuitively, *only* and *even* are doing nothing out of the ordinary here. The foci with which they associate may not be entirely conventional ones, but the nature of the association does not seem unusual—and since this association occurs, these must be considered 'real' cases of focus interpretation.

Such examples therefore look (and sound) like focus in every way that defines the phenomenon of focus. Given this, a theory of focus, semantic or otherwise, should surely extend to the explanation of these examples. As for their relationship to Artstein's examples, note that (15a) involves the use of an accent on a lexically unstressed syllable in order to produce a particular kind of contrastive meaning, which is the typical form of the cases that Artstein's proposals are designed to explain. Meanwhile, both (15a) and (15b) involve the production of meaningful contrasts via the contrast of word forms, as do Artstein's examples. It seems only reasonable to assume that a single analysis should cover all of these cases.

One potential objection to this line of reasoning (as argued by Artstein in personal communication) is based in the role of truth conditions. This objection goes roughly as follows: the reason for treating focus as a compositional semantic phenomenon is that it can affect truth conditions. In the same way, the reason to believe that examples like (7) and (10a) should be dealt with by the same compositional semantic analysis is that they too can affect truth conditions. For example, Artstein (2004) reports the intuition that (16a) (in American English) would generally be judged false if John brought home anything other than a rock from the cave, whereas (16b) could still be true if John brought home a rock, as long as he didn't also bring a stalactite.

(16) a. John only brought home a staLAGmite from the cave.
b. John only brought home a stalagMITE from the cave.

It is not clear, the argument goes, that examples like my (15a,b) bear the same relationship to truth conditions and therefore they may, or even should, be treated as a distinct phenomenon (which the general, compositional theory of focus need not account for).

There are two possible responses to this objection. One is to point out that the latter examples undoubtedly do involve truth conditional effects of focus, at some level. That is, they succeed in conveying propositional information which would not be conveyed without the particular uses of focus that they include. Consider again (5c), repeated here as (17).

(17) Q. Have you ever seen a STALagmite?
A. No. I've been into many caves, but I've only ever seen staLAGmites.

In this context, placing focus on the first syllable of the second instance of *stalagmite* would not create a coherent reply to the question, but the use of focus in (17) is comprehensible and, ultimately, informative (even if it principally passes information about the attitudes of the speaker). Thus, whatever the interpretive effect of focus is (and this example suggests it is a highly underspecified one), it affects meaning sufficiently to change an incoherent utterance into a fully felicitous one. This clearly means that a different proposition is expressed under each placement of focus. As such, truth conditions are affected[6]. This is no less true just because it does not occur in ways that are derivable (at least in any obvious way) using the techniques of compositional denotational semantics.

As mentioned in section 1, one way to analyse the interpretation of this example is to posit the interpolation of semantic material derived from post-Gricean processes of pragmatic enrichment. Under such an analysis, the meaning of the final clause would come out, roughly, as 'I've only ever seen *things that I recognise to be called* staLAGmites (*i.e. never things that I would recognise to be called* STAL*agmites*)'. Note that this preserves a standard interpretation of *only*, allowing it to affect truth-conditions in its usual way, something that would be oddly lacking without such enrichment.

The second response to the argument that non-truth-conditional uses of focus are not the same phenomenon as other kinds of focus is more philosophical and perhaps more important. The argument in question betrays an antecedent commitment to the notion that all and only truth conditional meaning must be dealt with through compositional semantic analysis. That is, if it affects truth conditions, it must derive directly from the grammar; if not, it need not. In the context of my arguments in this paper, and indeed of the whole workshop to which it contributes, this merely begs the question. Our aim is investigate *the extent to which* this idea of compositionality is sustainable—and in my case to present certain foci as evidence that it isn't.

Once we abandon any antecedent commitment to strict compositionality (and it is indeed a strict version that is implied here), it becomes an empirical matter whether a given linguistic phenomenon consistently maintains the ability to affect truth conditions or not. It then seems very odd to suggest that phenomena that look very similar in linguistic form, in interpretation and in combinatory possibilities with other items should not receive a unified explanation, just because in certain

[6] An obvious objection to this line of argument would be that the truth conditions of 'what is expressed' are not the same as the truth conditions of 'what is said'. But this entails an antecedent commitment to a certain kind of rather strictly compositional approach (see below), which is neither necessary nor clearly desirable. Post-Gricean approaches like Relevance Theory deny the very existence of 'what is said' as a cognitively significant notion, accepting that the meaning that is directly encoded in human languages regularly underspecifies propositional content. The relevant arguments cannot be rehearsed here for space reasons; the reader is referred to Carston (2002) (but see also section 5).

variants they do not clearly have truth-conditional effects. Using truth-conditions to delineate the scope of a linguistic phenomenon such as the interpretive process that relates to focus is rather like defining the class of birds by the ability to fly. We could of course do the latter (we can define our terminology how we like), but it would ultimately lead to very little zoological insight; in the same way, the former may end up telling us rather less than we'd like about the nature of the relationship between linguistic form and meaning.

I therefore stick to the view that 'focus is as focus does', with truth-conditional effects merely a possible outcome of whatever focus interpretation is. From this perspective, any theory that purports to capture the interpretation of focus should surely cover the interpretation of examples like those in (5). As I discuss in the following section, the Rooth/Artstein approach cannot do this, for reasons that stem not from the details of this approach but from its very commitment to a compositional denotational account.

4 The failure of focus semantics with 'metalinguistic' foci

Recall the additions required to extend a semantic theory of focus to cover examples of non-constituent focus such as focus on word parts, as summarised in (13) above. First, some consistent means of providing a denotation for the focused element must be provided. Second, there must be some consistent mechanism for integrating this denotation into that of the rest of the sentence, including the contribution of focus. This is precisely what Artstein (2004) provides, on the basis of the now-conventional assumption that a compositional approach to focus must involve reference to sets of alternatives.

A crucial part of this mechanism is the role of the unfocused word part, which comes to denote a function from sounds to word meanings. This is effective in dealing with focus interpretation as long as contrasted 'sound denotations' can ultimately be mapped in this way onto contrasting model-theoretic denotations—after all, interpretation in terms of 'alternative sets' depends on there being more than one non-identical denotation to form such a set. However, the examples in (5) illustrate that the following situations can be true:

(18)
1. Elements that combine with no shared unfocused material can be contrasted
2. Contrasted elements do combine with shared unfocused material, but they cannot be mapped onto contrasting entity denotations
3. Both 1 and 2 hold: i.e. contrasted elements do not combine with shared unfocused material, nor do they map onto contrasting entity denotations

These facts cannot be dealt with by Artstein's phonological decomposition theory, as in these cases it has no way of feeding an appropriate alternative set into a

semantic theory of focus. If 1 holds, there is no function available to map sounds onto the required word meanings; if 2 holds, such a function may be applied but will fail to produce an alternative set. I proceed to illustrate these problems in turn.

4.1 Type 1 examples: no common unfocused word part

An example of a case in which 1 holds is where a sub-word part is focused as an apparent addition to what is in fact merely a homophone. (5a), repeated again here as (19), is such a case (the example is invented, but is recognisable as a familiar, and perfectly interpretable, kind of verbal humour).

(19) It wasn't a steak. It wasn't even a MIstake—it was more of a crime against cookery.

As emphasised above, this has all the hallmarks of a clear sub-word focus example in Artstein's sense: focal stress falls on a syllable that would not be lexically stressed and yields a reading based in the drawing of a contrast (albeit one that is deliberately unconventional, for the sake of humorous effect). Also the 'association with focus' item *even* appears felicitously[7].

Now let us consider the problem with this example. Artstein's phonological decomposition will produce a denotation for the focused syllable, as its own sound. The problem lies in the next part of the account: the need for an unfocused word part (A in Artstein's rule in (14)) to act as a function from sounds to word meanings. Given that, as Artstein argues, there are at least some minimal requirements on the preservation of phonological structure in cases of sub-word focus, it is difficult to imagine that the 'unfocused word part' material in (19) could be -[teɪk], with the complex syllable onset [st]- split apart. Equally, it is intuitively plain that the similarity of the contrasted words in (19), upon which the whole impact of the utterance is based, is not limited to the final rhyme -[eɪk]. So whatever one considers the extent of the focused part to be (e.g. [mɪ] or [mɪs]), the shared material corresponding to the 'unfocused word part' must be the whole syllable [steɪk][8]. Plugging this into the interpretive procedure in (14), and thereafter into Roothian focus semantics, should yield a focus semantic value of the following form[9]: {*mistake, beefsteak, grubstake,...*}. Note that this does not contain the

[7] Ron Artstein has suggest to me (pc.) that this example is distinct from normal focus usage in that it involves an implicitly scalar meaning, rather than an alternative set-based interpretation as such. This suggestion does not seem to distinguish (19) from other uses of *even* which are widely accepted to involve association with focus: the contribution of *even* is always to convey that something at the low end of a scale of probability is nevertheless the case. Furthermore, there can be no simple 'scalar' analysis of (19), given that *steak* must be among the items that are implicitly to be related somehow to *mistake*. In any case, as various authors have argued (e.g. Hirschberg, 1991; Koenig, 1993; Scharten, 1997), 'scales' are essentially just ordered sets and seem to enter into the same interpretive processes as alternative sets (to the extent that either should be reified as such).

[8] According to my intuitions, one possible realisation of (19) would involve a slight pause between a stressed [mɪs] and unstressed [steɪk], hence with clear repetition of the segment [s]

[9] The nature of this set is of course dependent on the precise degree of phonetic similarity required; for example, perhaps only words with lexical stress on the second syllable should be considered

monosyllabic *steak*, as this does not conform to the definition in (14): if [steɪk] is the unfocused word part A, it cannot also qualify as a word with the form $A\beta$. It follows that Rooth's focus interpretation operator $\sim$ could not produce from this the required alternative set, $\{$*steak, mistake*$\}$.

There is one obvious way to rescue the phonological decomposition story for this kind of example, but certain significant problems would remain. This would be to assume that a monosyllabic word like *steak* could be re-analysed in just such a situation to have a representation [∅-steɪk], the null 'completion' of the form from the unfocused word part [steɪk] being sufficient to license its appearance with the FSV for MI*stake*. It is possible to imagine this re-analysis being part of the process of interpreting an example like (19), but this appears to presuppose inferential capabilities that render semantic focus mechanisms quite superfluous. The construction of a representation of this kind could only be motivated by the prior recognition that the alternative set $\{$*steak, mistake*$\}$ is required. This knowledge would in itself have to be derivable from the placement of phonological prominence in conjunction with context, hence the necessary *input* to Roothian semantics here presupposes a generally available independent means of achieving just what the semantics is there to do.

Nevertheless, the possibility of the [∅-steɪk] strategy might still be seen by an advocate of focus semantics to weaken the case against an approach like Artstein's. It is not so easy to undermine the significance of examples that come under categories 2 and 3 in (18): those that may or may not involve an unfocused word part, but lack contrastable extensional semantics.

4.2 Type 2 and 3 examples: no contrastable semantics

(5b), repeated here as (20), is a relevant example here.

(20) Q. Would you like some tom[eɪɾoʊz]?
A. Sorry, I only eat tom[a:toʊz].

Though differing from Artstein's key examples in that the location of focal stress here is the same as the location of lexical stress, it is plain from the only coherent interpretation that this is a case of focus below the word level. Indeed, if there is a case for introducing sounds as denotations, this kind of pronunciation-based example is surely one that should involve their use.

(20) provides an unfocused word part, [tɘm-], which could in principle provide a function from sounds to word meanings in order to integrate the 'sound denotations' into a compositional semantic derivation of the meaning of the sentence[10].

alongside *mistake*. Example (5c) further illustrates of the potential complications caused by lexical stress in the construction of alternative sets.

[10]Again, one might argue about the correct division of the word into sub-word units under a phonological decomposition analysis. Perhaps the focused part would have to include the [m] as the onset of the second syllable, leaving only [tɘ-] as the unfocused part. This would evidently change the focus semantic value created in such a story, but this does not affect my argument here.

The problem is that the application of this function would in itself destroy the possibility of deriving the appropriate alternative set. This is because the contrasted elements in (20) do not correspond to contrasting word meanings.

Applying a function that conforms to Artstein's definition (14) would produce a focus semantic value containing terms such as the following: $\{$*tomatoes′, tomorrow′, tomography′, tamoxifen′, temerity′*$\}$—that is, the extensions of words formed by 'completing' the unfocused part. Given such a FSV, the Roothian $\sim$ operator cannot construct an alternative set that reflects the intuitive interpretation of (20). This is because $\sim$ operator is required to produce a set that contains the ordinary semantic value of the focus-affected expression *and* at least one other member—a requirement that is quite essential to a coherent alternative semantics in its usual applications. The interpretation of (20) does not involve a contrast between *tomatoes′* and any other member of the aforementioned FSV. In this way, the process of converting 'sound denotations' to conventional extensions, the very basis of Artstein's account, prevents the construction of the alternative set that is intuitively involved in the interpretation of the utterance at hand. Because this is the point at which the analysis fails, it is clear that the problem does not lie with the choice of Rooth's alternative semantics in particular; what causes trouble is nothing other than the attempt to produce a mechanistic means of converting 'metalinguistic' foci into fodder for a compositional semantic account of focus-affected meaning. Yet, as I have argued above, such foci cannot be simply set aside, either. Consequently, we must conclude that focus cannot be given a compositional semantic account (despite its ability to affect truth conditions).

The case of (5b)/(17) illustrates the third type of example from the list in (18), involving neither a consistent unfocused word part nor a suitable denotational contrast. Because the British English and American English pronunciations of *stalagmite* differ in the location of lexical stress and because focal stress is used to emphasise precisely this difference, the 'unfocused part of the word' inevitably fails to be something that is common to both of the contrasted forms, so cannot be used as a function of the kind described in (14). At the same time, no alternative set could be defined using only lexically encoded denotational semantics, as word meaning is held constant across the contrasted elements, as in (20).

(5d), repeated here as (21), is similarly problematic for an alternative semantics (or any comparable) approach in both of the ways outlined in (18).

(21) Q. Do you really eat rutabaga at Burns suppers?
A. We only eat NEEPS.

Since *neeps* and *rutabaga* have precisely the same denotation, across their respective dialects of English, a compositional focus semantics is left without the resources to derive the appropriate focus-affected reading. Meanwhile, this focus-indicated contrast of whole words precludes from the outset the derivation and integration of any 'sound denotation' by Artstein's mechanisms. Indeed, this kind of example demonstrates clearly that the issue is not merely one of sub-word focus

and of Artstein's response to it. There are also uses of focus at the word level (involving contrastive meanings, association-with-focus and so on) which cannot be accounted for by theories that merely manipulate unenriched linguistically encoded meanings.

5 Inference in focus

5.1 The broader context

While the primary aim of this article is to argue a point about compositionality using focus as an illustration, it behooves me also to say a few words about how non-compositional focus interpretation might work. These two aims may be addressed together through a brief discussion of some broader theoretical issues[11].

My broader reasons for questioning strict compositionality stem from the central concern of what might be termed a 'radical pragmatics' perspective: we should not over-burden and over-complicate our grammar-semantics interface with mechanisms that exist only to derive what independently necessary pragmatic principles will deliver for free. In fact, I see nothing inherently 'radical' in this observation, which should follow from the basic aim of all approaches to linguistic semantics: to understand how human languages actually encode meaning and what this encoded meaning is.

On the other hand, much of what has been called 'radical pragmatics' has been strikingly non-radical in accepting the traditional equation of encoded meaning with truth-conditional meaning. This is something that Relevance Theory (Sperber and Wilson, 1986) does not do, concentrating instead on the more basic and logically separate issue of distinguishing *encoded* from *inferred* meaning, without pre-judging the nature of the former. On the relevance-theoretic view, encoded meanings (the output of the grammar-meaning interface) may be significantly underspecified, only reaching propositional status as the result of relevance-driven and context-dependent processes of reasoning.

The significance of this for the study of focus should be clear: the existence of cases like (1), or indeed of the truth conditions of (16b), does not constitute evidence in favour of a semantic theory of focus. Instead, focus interpretation as such may consist in some fairly underspecified, possibly procedural, meaning which, via processes of pragmatic enrichment, can come to affect truth-conditions. In addition, operators like *only* can introduce truth-conditional effects and can, in effect, also come operate over the results of pragmatic enrichment, thus avoiding the apparent problem of such operators associating with non-denoting foci. The latter case is, of course, what I envision in my informal presentation of how focus and context interact in (6).

The 'enrichment' referred to in the context of (6) is thus a general process, by no means specific to focus. Furthermore, the kind of illustration given there may

[11] These issues are addressed at length in Wedgwood (2005).

be only the very tip of the iceberg; focus may be a quite radically underspecified matter. I do not attempt to pin it down exactly here, but I do note that it requires much more evidence than the likes of (1) to argue that focus is in fact anything more than a kind of phonological 'pointing', a very general indicator of where the particular relevance of some utterance is to be found (for some approaches along these lines within Relevance Theory, see Breheny, 1998; Sperber and Wilson, 1986, 202–217)[12].

5.2 Alternatives emerge

Contrary to common assumptions in the focus semantics literature, the regular perception that 'alternative sets' are involved in focus interpretation only strengthens the case for a radical-pragmatic view of focus. Practically all analysts are agreed that focus is strongly correlated with the 'new' information in an utterance (note that this is to be expected even on the minimal view that focus is a pointer indicating where the addressee's attention should be concentrated). Given this, well known pragmatic processes predict that focus will be associated with the evocation (and typically elimination) of contextually relevant alternatives to what is asserted.

When an assertion is made in the context of some background information, certain expectations regarding this 'background' are typically invoked and these are subsequently confirmed or contradicted by the assertion. It is precisely such effects on prior knowledge or expectations that make communication worthwhile (Sperber and Wilson, 1986, 103ff.), so they can be expected to have significant consequences for the process of interpretation. Thanks to the basic principles of efficient communication that create the effect known from the Gricean literature as 'quantity implicature', the most common consequence of an assertion will be to imply (to some degree, depending on contextual factors) that its alternatives do not hold. 'Alternative sets' therefore emerge on the back of assertions, just to the extent that their members are relevant[13].

For example, take a simple case like (22):

(22) LIZ plays viola.

As long as ones theory of focus allows one to recognise (by whatever means) that in this case the matter of people playing viola is 'under discussion' (something that is likely to be manifestly the case in advance of such an utterance anyway) and that *Liz* is new information in respect of this, then this assertion will, by normal and quite general pragmatic processes, imply the rejection of any contextually relevant alternative assertion (i.e. that some other salient individuals play viola). Similarly, examples like *Kim found a stalag*MITE can be recognised as an assertion made in

[12] Glanzberg (2005), who without justification labels this 'the pessimistic view' of focus, associates this approach with the work of Bolinger. It is important to note that one need not follow Bolinger's denial of structural constraints on focus placement (e.g. Bolinger, 1972) in order to maintain a heavily underspecified *interpretation* of focus.

[13] Wedgwood (2005) argues this point in detail, in the context of a discussion of focus in Hungarian.

the context of information that is either genuinely 'discourse-old' or implied to be through the speaker's use of focus. This leads to an analysis that is not far removed from Artstein's, in that the number of relevant possible assertions that may be made in the context of the very particular 'background' information that 'Kim found a stala(g)-*X*' is limited to two.

The pragmatic and semantic analyses are however distinguished by the likes of (5a–d), as we have seen, since in the latter the relevant kinds of contrast cannot be derived from the linguistically encoded material alone, nor can they be calculated directly from the position of focus alone. They can, however, be calculated on the basis of focus placement combined with addressees' inferences regarding the possible communicative intentions that would render each utterances relevant. For example, asserting *We only eat* NEEPS in (5d)/(21) invites interpretation in the context of relevant possible assertions about 'what we eat', the most salient being 'we eat rutabaga', thanks to the explicit preceding question. In this context, presenting *neeps* as new, relevant information leads to incoherence if the denotation alone is considered: the assertion is that *brassica napobrassica* (*qua* neeps) is eaten, yet the implication is that *brassica napobrassica* (*qua* rutabaga) is not eaten. There is, however, an obvious way to take the utterance as conveying a relevant proposition: concentrate on the form of the words used. This yields a meaning parallelling the one in (6b). Note that this results from the same focus-related background/assertion structure used in a simple example like (22), only via a series of inferences that are licensed by the addressee's search for a relevant interpretation (which, as Sperber and Wilson, 1986 argue, is a very general process).

Hence, the simple connection between focus and assertion of new information is sufficient to derive the evocation of, and contrasts within, sets of alternatives in identifiable cases of the use of focus. No semantic mechanisms are necessary to achieve this. This is just as well, since, as I have demonstrated in this paper, the kinds of alternative sets evoked in certain cases of focus interpretation cannot be characterised as sets of denotations derived by rule from any element of the linguistically encoded meaning contained in the utterance—however far one extends one's notion of linguistically encoded meaning.

6 Summary

Focus interpretation represents a challenge to strict compositionality because the latter entails that contributions to meaning that affect truth conditions must be directly encoded in grammatical mechanisms[14]. Focus can affect truth conditions but I have discussed numerous cases of what must be viewed as the use of focus

[14] At least, it does on the usual understanding of compositionality within linguistic semantics. As Pelletier (1994, 11) points out, in fact "The Principle [of Compositionality] makes no assumptions about what meaning is, nor does it say how one can tell whether two expressions have the same or different meanings". One particular notion of compositionality is generally assumed within discussions of linguistic phenomena like focus, however, and I address only this.

which cannot be dealt with by directly encoded denotational semantic processes. These are typically examples that revolve around 'metalinguistic' contrasts drawn between the forms of words, but even an extension of denotational semantics which is designed to deal compositionally with parts of words cannot deal with these examples. This leaves two possibilities: (i) to deny that these are cases of focus interpretation at all or (ii) to conclude that strict compositionality leads to contradictory conclusions and should be abandoned. I argue for (ii), on the grounds that (i) creates a quite artificial division in the data, in the face of evidence from both form and interpretation, and on the grounds that there exist good metatheoretical reasons to reject a presumption of compositionality in any case.

Under a non-compositional, pragmatics-rich approach, based on the insights of the post-Gricean framework Relevance Theory, the crucial 'metalinguistic' examples of focus are unproblematic and follow from very general principles of reasoning—once these are allowed to enrich the contribution of linguistically encoded meaning in the course of deriving propositional meaning. This leaves the precise nature of focus open, preserving the possibility that it is quite radically underspecified in its underlying contribution to propositional meanings.

References

Artstein, Ron. 2002a. A Focus Semantics for Echo Questions. In Ágnes Bende-Farkas and Arndt Riester (eds.), *Workshop on Information Structure in Context*, pages 98–107, Stuttgart: IMS, University of Stuttgart.

Artstein, Ron. 2002b. Parts of Words: Compositional Semantics for Prosodic Constituents, unpublished Ph.D. Thesis, Rutgers University.

Artstein, Ron. 2004. Focus Below the Word Level. *Natural Language Semantics* 12(1), 1–22.

Artstein, Ron. to appear. Coordination of parts of words. *Lingua* .

Bolinger, Dwight. 1972. Accent is predictable (if you're a mind-reader). *Language* 48, 633–644.

Breheny, Richard. 1998. Interface Economy and Focus. In Villy Rouchota and Andreas H. Jucker (eds.), *Current Issues in Relevance Theory*, pages 105–139, Amsterdam: John Benjamins.

Carston, Robyn. 2002. *Thoughts and Utterances: The Pragmatics of Explicit Communication*. Oxford: Blackwell.

Glanzberg, Michael. 2005. Focus: A Case Study on the Semantics/Pragmatics Boundary. In Zoltán Gendler Szabó (ed.), *Semantics versus Pragmatics*, pages 72–110, Oxford: Oxford University Press.

Hirschberg, Julia. 1991. *A Theory of Scalar Implicature*. New York: Garland.

Horn, Laurence. 1989. *A Natural History of Negation*. Chicago and London: The University of Chicago Press.

Koenig, Jean-Pierre. 1993. Scalar Predicates and Negation: Punctual Semantics and Interval Interpretations. In L. Dobrin, L. Nichols and R. Rodríguez (eds.), *CLS27: Papers from the 27th Regional Meeting of the Chicago Linguistic Society, 1991. Part Two: The Parasession on Negation*, pages 140–155, Chicago: Chicago Linguistic Society.

Noh, Eun-Ju. 2000. *Metarepresentation: A Relevance Theory Approach*. Amsterdam: John Benjamins.

Pelletier, F. J. 1994. The Principle of Semantic Compositionality. *Topoi* 13, 11–24.

Rooth, Mats. 1985. Association with Focus, Ph.D. thesis, University of Massachusetts, Amherst.

Rooth, Mats. 1992. A Theory of Focus Interpretation. *Natural Language Semantics* 1, 75–116.

Rooth, Mats. 1996. Focus. In Shalom Lappin (ed.), *The Handbook of Contemporary Semantic Theory*, pages 271–297, Oxford: Blackwell.

Scharten, Rosemarijn. 1997. Exhaustive Interpretation: A Discourse-Semantic Account, Ph.D. thesis, Katholieke Universiteit Nijmegen.

Sperber, Dan and Wilson, Deirdre. 1986. *Relevance: Communication and Cognition*. Oxford: Blackwell, (Second Edition: 1995).

von Heusinger, Klaus. 2004. Focus Particles, Sentence Meaning and Discourse Structure. In Alice G. ter Meulen and Werner Abraham (eds.), *The Composition of Meaning: From lexeme to discourse*, Amsterdam: John Benjamins.

Wedgwood, Daniel. 2005. *Shifting the Focus: From Static Structures to the Dynamics of Interpretation*. Oxford: Elsevier.

Underspecification and NP Coordination in Constraint-based Grammar

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Abstract

This paper presents a uniform semantic underspecification account of conjunctive NP coordination phenomena, with particular focus on scope and plural ambiguities. We propose a compositional and constraint-based approach for processing pluralities within an integrated UDRT (Reyle, 1993) and HPSG (Pollard and Sag, 1994) framework, with the goal of capturing complex semantic interactions that can arise in such structures.

1 Introduction

Semantic Underspecification has been successfully employed to avoid the combinatorial explosion caused by scope ambiguities (e.g. QLF (Alshawi and Crouch, 1992), UDRSs (Reyle, 1993), MRS (Copestake et al., 1995), Hole Semantics (Bos, 1996), CLLS (Egg et al., 2001) and LRS (Richter and Sailer, 2001) among others). Still, the underspecification literature has been relatively silent regarding NP coordination phenomena, most likely because of the complex issues raised about conjunction and the semantics of pluralities, as these are still the topic of much linguistic debate. However, recent efforts to deal with scopal phenomena and coordination in underspecified semantics seem to challenge strict compositionality, by making use of copying operations. We will in turn argue against such analysis and propose a compositional and underspecified constraint-based account of scope ambiguities as well as distributive and collective readings triggered by pluralities.

Section 2 overviews a previous underspecification proposal on NP coordination and points out some of the linguistic problems and computational issues. In section 3 a uniform and compositional account for the fragment under discussion is proposed, dealing with scope and plural ambiguities in a general way. Several related issues concerning anaphora, reciprocity and model theory are also briefly discussed. Finally, section 4 concludes.

2 NP Coordination

In early Transformational Grammar, coordination structures like the one in (1) were analyzed via a transformation known as Conjunction Reduction (CR) to yield a sentential coordination:

(1) John and Mary smiled.
$(\exists x\, \mathsf{John}(x) \wedge \mathsf{smiled}(x)) \wedge (\exists y\, \mathsf{Mary}(y) \wedge \mathsf{smiled}(y))$

However, Lakoff and Peters (1969), Massey (1976), Roberts (1987), and others noted that some NP coordinations cannot be reduced to sentential coordination:

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(2) a. Tom, Dick and Harry are similar.
b. John and Mary are a happy couple.
c. Tom, Dick and Harry lifted the piano.
d. John and Mary praised each other.
e. A car and a bike collided.

In the examples above, the subject NP is a *conjoined plurality* which is taken in a collective state-of-affairs. Conjoined NPs can also yield scope ambiguities, and Babko-Malaya (2004) recently proposed a LTAG grammar account using an underspecification language similar to Hole Semantics (following Kallmeyer and Joshi (2003)), with the goal of dealing with scope ambiguities triggered by the coordination of quantificational NPs such as the one in (3):

(3) Every man and every woman solved a puzzle.

However, this account assumes an approach similar to (1) since the disambiguation process copies-out several items (in this case, the verbal head and the object NP), in order to produce the representations in (4) (Babko-Malaya 2004):

(4) a. $\mathsf{every}(x, \mathsf{man}(x), \mathsf{some}(z, \mathsf{puzzle}(z), \mathsf{solve}(x, z))) \wedge$
$\mathsf{every}(y, \mathsf{woman}(y), \mathsf{some}(z, \mathsf{puzzle}(z), \mathsf{solve}(y, z)))$

b. $\mathsf{some}(z, \mathsf{puzzle}(z), \mathsf{every}(x, \mathsf{man}(x), \mathsf{solve}(x, z)) \wedge$
$\mathsf{every}(y, \mathsf{woman}(y), \mathsf{solve}(y, z)))$

Copying-out over conjuncts is computationally costly since it is associated to the possible scope disambiguations, which are exponential (Dik 1968:78). This can be observed in (5) where the entire relative clause as well as the VP have to be copied in order to obtain narrow scope readings of both indefinite NPs:

(5) Every man and every woman who solved a puzzle won a prize.

This kind of CR analysis also fails to obtain *collective* interpretations for (2). One should not use a coordination rule just for quantificational NPs because these can have collective readings (Roberts 1987:166; Hoeksema 1988; Lønning 1989):

(6) a. Every soldier and every officer met.
b. Every man and every woman praised each other.
c. Every professor and every student of his wrote a paper (together).
d. Actually, every proton and every neutron collided in the chamber.

Mixed coordinations of different kinds of NPs can be collectively targeted by anaphoric expressions, as seen below:

(7) [The reverend and every member of the congregation]$_i$ crossed themselves$_i$ as the soldiers filed past.

Analyzing these data as elliptical thus comes at the cost of both parsimony and computational efficiency, even though such constructions do not occur very often. According to informants, some cases actually require very specific pragmatic con-

texts (e.g. to emphasize that each and every entity is involved in the event) in order to be acceptable. Yet we believe there is nothing ungrammatical about the above, and that any processing difficulties are due to their structural complexity, which as we shall see, entail a significant degree of semantic ambiguity.

There are other cases of coordinated quantificational NPs which should also be considered, namely ones involving a kind of *Hydra* (Link, 1984) where the same NP is interpreted distributively as well as collectively:

(8) a. Every woman and every child gathered at the embassy will be assisted by a red cross medic.

b. Each boy and each girl holding a card with the same number will have to kiss.

c. Every landlord and every tenant who hate each other end up shouting during meetings.

In (8a) the relative clause headed by *gather* requires a collective reading, while the main predicate *be assisted* ranges over individuals. Example (8b) pertains to the context of a child play where each boy and each girl draws a card from two decks respectively, such that the couples with matching cards are dared to kiss.

Carpenter (1997:325) notes yet another source of ambiguity, which we believe cannot easily be addressed in a copy-out approach such as the one in Babko-Malaya (2004), arising from scope interactions *between* conjuncts:

(9) a. Every student and a friend can come to the party.
b. Every inmate and a guard must enter the X-ray room.
c. Every lawyer and each client must wait in line.
d. Each student and his or her advisor should meet once a week.

In (9a,b) the indefinite determiner can have wide or narrow scope relatively to the universal quantifier, yielding a specific or a non-specific reading respectively. The latter allows a different friend or guard for each student or inmate, respectively. (9d) is similar, where in addition the anaphora may or not be local.

The above data are also problematic for branching quantification accounts such as Barwise (1979) and Lønning (1989). An important generalization is also missed in these proposals because several reciprocal predicates are assumed. For instance, a binary $agree_1$ for 'every linguist and every logician agree' as seen in (10), a unary $agree_2$ for 'the linguists agree', a ternary $agree_3$ for 'every linguist, every philosopher and every logician agree', and so on.

(10) $\begin{pmatrix} \text{every x linguist(x)} \\ \text{every y logician(y)} \end{pmatrix}$ agree(x,y)

In the next section we propose an account of NP Coordination which is consistent with all of the above phenomena, using the same underlying semantic construction, regardless whether the NP conjuncts are quantificational or not.

3 Underspecifying NP Coordination

In the fragment under consideration, NP coordination always yields a non-atomic entity (a *plurality*) which may be interpreted collectively or distributively. There is little agreement on the exact linguistic and philosophical nature of such entities, and for now we will agnostically steer away from the controversy by assuming a 'set formation' operation which may be formalized in many different ways,[1] and concentrate on the goal of providing a general semantic construction constraint that uniformly captures scopal and plural interpretations for such structures.

We start by illustrating our proposal with an example, using standard subordination relations to encode scopal restrictions. Below is depicted the underspecified structure of a sentence that includes a non-trivial NP coordination, where arrows correspond to scope subordination relations ('$\leq$'):

(11) Every lawyer and his secretary will meet tomorrow.

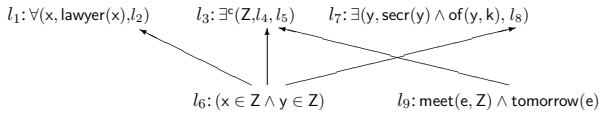


Figure 1: NP Coordination Underspecification

This underspecified structure allows conjuncts to outscope the coordinator, as well as each other: each conjunct outscopes the conjunction l_6, but remains underspecified relatively to the set-formation ($\exists^c$) introduced by the coordinator in l_3. Thus if l_2 is disambiguated as outscoping l_7 as well as the set-formation, one obtains a pair reading where each lawyer meets the respective secretary:[2]

(12) $\forall(x, \text{lawyer}(x), \exists(y, \text{secr}(y) \wedge \text{of}(y, x), \exists^c(Z, x{\in}Z \wedge y{\in}Z, \text{meet}(e, Z) \wedge \text{tomr}(e))))$

In that case, the nested indefinite NP is interpreted non-specifically, a suitable referent is locally accessible ($k = x$), and external anaphora are blocked:

(13) Every lawyer$_i$ and his$_i$ secretary$_j$ met yesterday. *She$_j$ was worried.

However, if the set-formation is disambiguated as outscoping both conjuncts, a reading obtains where everyone is meeting (including lawyers meeting lawyers and secretaries meeting secretaries), since Z contains every individual introduced by each NP conjunct:

(14) $\exists^c(Z, \forall(x, \text{lawyer}(x), \exists(y, \text{secr}(y) \wedge \text{of}(y, x), x{\in}Z \wedge y{\in}Z, \text{meet}(e, Z) \wedge \text{tomr}(e))))$

[1] E.g. as a first-order or as a second-order entity. See §3.4 for more on this discussion.

[2] Henceforth the semantics of *meet* is abbreviated, as it should lexically distribute over the members of Z reciprocally, e.g. l_9:$\forall(k, k{\in}Z, \forall(w, w{\in}Z \wedge k{\neq}\, w, \text{meet}'(e, k, w)))$.

Note that the latter reading is quite salient in the child play lottery context of (8b) above. This kind of ambiguity is also visible in the example below, where either everyone meets, or only pairs of a man and a woman meet:

(15) Every man and every woman shall meet in the temple tonight.

a. $\forall(\mathsf{x}, \mathsf{man}(\mathsf{x}), \forall(\mathsf{y}, \mathsf{woman}(\mathsf{y}), \exists^{\mathsf{e}}(\mathsf{Z}, \mathsf{x} \in \mathsf{Z} \wedge \mathsf{y} \in \mathsf{Z}, \mathsf{meet}(\mathsf{e}, \mathsf{Z}) \wedge \mathsf{ton}(\mathsf{e}) \wedge \ldots)))$

b. $\exists^{\mathsf{e}}(\mathsf{Z}, \forall(\mathsf{x}, \mathsf{man}(\mathsf{x}), \forall(\mathsf{y}, \mathsf{woman}(\mathsf{y}), \mathsf{x} \in \mathsf{Z} \wedge \mathsf{y} \in \mathsf{Z})), \mathsf{meet}(\mathsf{e}, \mathsf{Z}) \wedge \mathsf{ton}(\mathsf{e}) \wedge \ldots)$

Conversely, if the indefinite determiner is disambiguated as outscoping the universal quantifier ($l_8 = l_1$), then *his secretary* may be interpreted specifically provided that a suitable binding referent is accessible in the discourse:[3]

(16) The office director$_i$ scheduled an extra meeting this afternoon. Every lawyer and his$_i$ secretary will also be required to attend.

Note that intermediate scopings yield equivalent readings, e.g. $every_x > exists_Z > every_y$ corresponds to each man meeting the members of the set of women. Similarly, scope interactions between existentially quantified conjuncts do not result in distinct readings.

(17) John and Mary met.
$\exists^{\mathsf{e}}(\mathsf{Z}, \exists(\mathsf{x}, \mathsf{John}(\mathsf{x}), \exists(\mathsf{y}, \mathsf{Mary}(\mathsf{y}), \mathsf{x} \in \mathsf{Z} \wedge \mathsf{y} \in \mathsf{Z})), \mathsf{meet}(\mathsf{e}, \mathsf{Z}))$

This is a well known side-effect of scope processing. For example, 10 of the representations usually obtained for the sentence below in most formalisms (underspecified or not) are logically equivalent:[4]

(18) Every man in a bar bought a woman a drink.

3.1 Formalization

We now formalize the coordination clause for the underspecified representation in (11). In HPSG, syntactic and semantic structures are construed via independent implicational constraints which mutually express different kinds of information associated to the same complex linguistic entities. Our semantics constraint should thus be grounded in syntactic structure, and for this purpose we adopt the coordination constraint proposed in Beavers and Sag (2004).

In terms of the semantic framework, we adopt in general terms the Underspecified DRT/HPSG interface in Frank and Reyle (1995).[5] NP Coordination is captured with two different constraints: a conjunction-marking base structure (*hd-mk-cx* in (19)) and a recursive NP conjunction structure (*cnj-cx* in (20)):

[3] In fact, an alternative way to capture the scopal flexibility between conjuncts could be through presupposition projection and accommodation, as in van der Sant (1992).

[4] See Chaves (2003) for techniques to avoid this problem in an underspecification setting.

[5] For technical reasons our representation of determiners is slightly different from the original, as it singles out the arguments explicitly, similarly to MRS and LUD (Bos, 1999), as discussed below. Also, we employ lists rather than sets, since these are computationally much simpler, and no linguistic requirement exists for using sets presently.

(19)
$$\left[\begin{array}{l}\textit{hd-mk-cxt}\\ \mathrm{MTR} \mid \mathrm{SEM}\left[\begin{array}{ll}\mathrm{INDEX} & \boxed{Z}_{non-at}\\ \mathrm{LS} & \left[\begin{array}{l}\text{L-MAX } \boxed{l}\\ \text{L-MIN } \boxed{l2}\end{array}\right]\\ \mathrm{SUBORD} & \left\langle \boxed{l_3} \leq \boxed{l_1}, \boxed{l_3} \leq \boxed{l_4} \right\rangle \oplus \boxed{4}\\ \mathrm{CONDS} & \left\langle \left[\begin{array}{ll}\mathrm{LABEL} & \boxed{l_3}\\ \mathrm{REL} & \in\\ \mathrm{ARG1} & \boxed{x}\\ \mathrm{ARG2} & \boxed{Z}\end{array}\right], \left[\begin{array}{ll}\mathrm{LABEL} & \boxed{l}\\ \mathrm{REL} & \textit{exists\_cnj}\\ \mathrm{DREF} & \boxed{3}\\ \mathrm{RES} & \boxed{l_1}\\ \mathrm{SCOPE} & \boxed{l_2}\end{array}\right] \right\rangle \oplus \boxed{5}\end{array}\right]\\ \mathrm{DTRS}\left\langle \left[\begin{array}{l}\textit{conj-lxm}\\ \mathrm{SYN} \mid \mathrm{SPEC}\ \boxed{1}\\ \mathrm{CRD}+\end{array}\right], \boxed{1}\mathrm{NP}_{CRD-}\left[\begin{array}{ll}\mathrm{INDEX} & \boxed{x}\\ \mathrm{LS} \mid \text{L-MIN} & \boxed{l_4}\\ \mathrm{SUBORD} & \boxed{4}\\ \mathrm{CONDS} & \boxed{5}\end{array}\right] \right\rangle\end{array}\right]$$

The above NP conjunction marking constraint roughly corresponds to a schema $\mathrm{NP}_{CRD+} \rightarrow \textit{conj}\ \ \mathrm{NP}_{CRD-}$. Note that all semantic information is introduced constructionally by the mother node, allowing the same lexical entry for the conjunction *and* to be used in the coordination of other categories (verbal, adjectival, etc.).

The construction in (20) captures the recursive case $\mathrm{NP} \rightarrow \mathrm{NP}\ \mathrm{NP}_{CRD+}$. Here, the extra conjoined NP triggers the introduction of an additional '$\boxed{y} \in \boxed{Z}$' constraint between the nominal referent $\boxed{y}$ and the conjoined non-atomic referent $\boxed{Z}$, as well as the respective subordination constraints:

(20)
$$\left[\begin{array}{l}\textit{cnj-cx}\\ \mathrm{MTR} \mid \mathrm{SEM}\left[\begin{array}{ll}\mathrm{INDEX} & \boxed{Z}_{non-at}\\ \mathrm{LS} & \boxed{1}\\ \mathrm{SUBORD} & \left\langle \boxed{l_5} \leq \boxed{l_4}, \boxed{l_5} = \boxed{l_3} \right\rangle \oplus \boxed{2} \oplus \boxed{4}\\ \mathrm{CONDS} & \left\langle \left[\begin{array}{ll}\mathrm{LABEL} & \boxed{l_5}\\ \mathrm{REL} & \in\\ \mathrm{ARG1} & \boxed{y}\\ \mathrm{ARG2} & \boxed{Z}\end{array}\right] \right\rangle \oplus \boxed{3} \oplus \boxed{5}\end{array}\right]\\ \mathrm{DTRS}\left\langle \mathrm{NP}\left[\begin{array}{ll}\mathrm{INDEX} & \boxed{y}\\ \mathrm{LS} \mid \text{L-MIN} & \boxed{l_4}\\ \mathrm{SUBORD} & \boxed{4}\\ \mathrm{CONDS} & \boxed{5}\end{array}\right], \mathrm{NP}_{CRD+}\left[\begin{array}{ll}\mathrm{INDEX} & \boxed{Z}\\ \mathrm{LS} & \boxed{1}\\ \mathrm{SUBORD} & \boxed{2}\left\langle \boxed{l_3} \leq \boxed{l_1} \mid \ldots \right\rangle\\ \mathrm{CONDS} & \boxed{3}\end{array}\right] \right\rangle\end{array}\right]$$

The types *hd-mk-cxt*, *cnj-cx*, and *conj-lxm* can be extended to allow disjunctive coordinations and other kinds of conjunctions (e.g. appositive NP coordination).

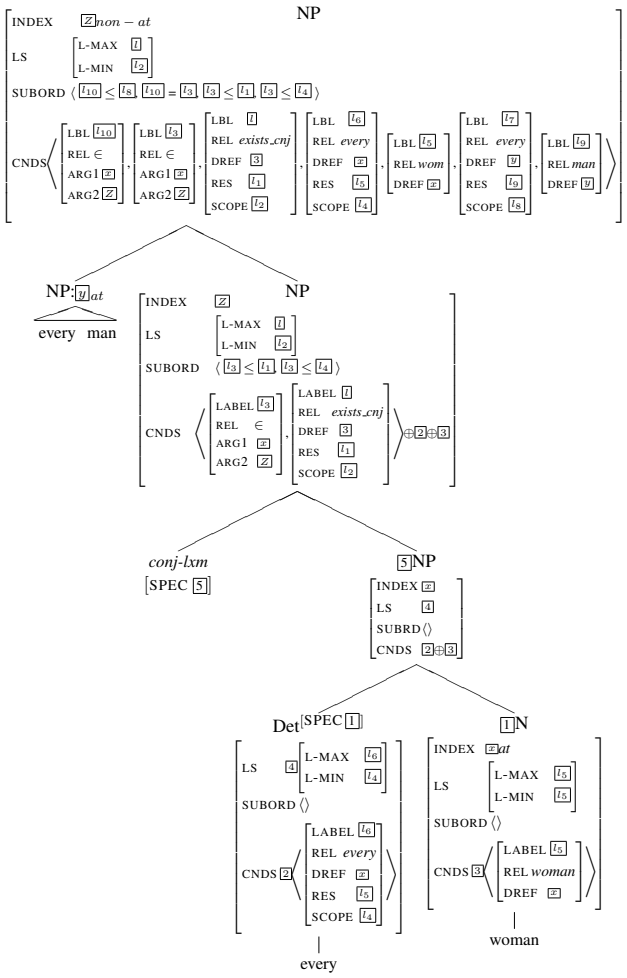


Figure 2: NP Coordination Semantic Construction

The structure in Figure 2 illustrates how the semantic composition of 'every man and every woman' proceeds in our grammar fragment ('a man and a woman' or 'each lawyer and an assistant' are obtained similarly). The resulting NP makes available a non-atomic referent $\boxed{Z}$ which may be taken by a collective predicate such as *meet* and *agree*, regardless of how the conjuncts scopally interact.

We opted for a uniform representation of existential and quantificational determiners which explicitly encodes the arguments in RESTR and SCOPE. This notation prevents scopal interactions between the two arguments (e.g. a distribution introduced by a relative clause cannot outscope the main verb) given the negative constraints stated in Reyle (1996:345,ft.3). Once scope is resolved, existential determiners can be interpreted in the usual way, by having the argument DRSs merged into the main DRS introduced by the determiner. For instance, via equality subordination constraints between the respective labels:

(21) $\begin{bmatrix} \text{LABEL } \boxed{l} \\ \text{REL } \textit{exists} \\ \text{DREF } \boxed{x} \\ \text{RES } \boxed{l1} \\ \text{SCOPE } \boxed{l2} \end{bmatrix} \equiv l: \begin{array}{|c|}\hline x \\ \hline \\ \hline \end{array}$ where $l = l_1 = l_2$

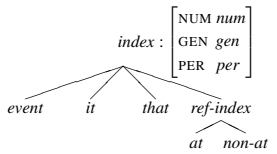
Here we assume generalized quantifiers correspond to standard duplex conditions in Kamp and Reyle (1993). After the equality subordination constraints are factored out, the underspecified DRS in Figure 2 boils down to the depicted below:

(22) $\langle l_3 \leq l, l_3 \leq l_8, l_3 \leq l_4 \rangle$

$\langle l_3: \begin{array}{|c|}\hline x \in Z \\ y \in Z \\ \hline \end{array}$, $l: \begin{array}{|c|}\hline Z \\ \hline \\ \hline \end{array}$, $l_6: \begin{array}{|c|}\hline x \\ \hline \text{woman}(x) \\ \hline \end{array} \Rightarrow \boxed{l_4}$, $l_7: \begin{array}{|c|}\hline y \\ \hline \text{man}(y) \\ \hline \end{array} \Rightarrow \boxed{l_8} \rangle$

For the typing of pluralic and atomic indices in INDEX and ARG, we will assume the following *index* type hierarchy based on Pollard and Sag (1994):

(23)



This signature allows to distinguish between several different kinds of nouns: singular atomic (e.g. *student*), singular non-atomic (e.g. *herd*), plural atomic (e.g. *trousers*), and plural non-atomic (e.g. *students*, composed of pure atoms or *herds*, composed of group atoms). Thus a collective verb can select NPs that introduce non-atomic referents, without the need to distinguish complex NPs like 'John and a student' (where INDEX is typed *non-at* by the clause in (19)) from simple plural NPs like 'some students' (where INDEX is lexically typed *non-at* by the noun):

(24)
$$\left\langle \textit{met}, \left[\begin{array}{l} \textsc{arg-st}\ \langle\ \textsc{np}: \left[\begin{array}{l}\textsc{index}\ \boxed{1}\textit{non-at}\\ \textsc{ls}\mid\textsc{l-min}\ \boxed{l1}\end{array}\right]\rangle \\ \textsc{sem}\left[\begin{array}{l}\textsc{index}\ \boxed{e}\\ \textsc{ls}\ \left[\begin{array}{l}\textsc{l-max}\ \boxed{l2}\\ \textsc{l-min}\ \boxed{l2}\end{array}\right]\\ \textsc{subord}\ \langle\ \boxed{l2}\leq\boxed{l1}\ \rangle\\ \textsc{conds}\left\langle\left[\begin{array}{ll}\textsc{label}&\boxed{l2}\\ \textsc{rel}&\textit{meet}\\ \textsc{arg0}&\boxed{e}\\ \textsc{arg1}&\boxed{1}\end{array}\right]\right\rangle\end{array}\right]\end{array}\right]\right\rangle$$

Conversely, the typing on the subject index rules out atomic subjects (*iff* the structure is intransitive and not an instance of null complement ellipsis):

(25) a. # Each student met / gathered.
b. # A student met / gathered.

In *head-subject* and *head-complement* constructions semantic composition is rather straightforward, following closely from the Semantics Principle in Frank and Reyle (1995), with the following monotonic constraint:

(26)
$$\left[\begin{array}{ll}\textsc{mtr}\mid\textsc{sem} & \left[\begin{array}{l}\textsc{index}\ \boxed{1}\\ \textsc{ls}\ \boxed{2}\\ \textsc{subord}\ \boxed{s_1}\oplus\boxed{s_2}\oplus\ldots\oplus\boxed{s_n}\\ \textsc{conds}\ \boxed{c_1}\oplus\boxed{c_2}\oplus\ldots\oplus\boxed{c_n}\end{array}\right]\\ \textsc{hd-dtr}\mid\textsc{sem} & \left[\begin{array}{l}\textsc{index}\ \boxed{1}\\ \textsc{ls}\ \boxed{2}\\ \textsc{subord}\ \boxed{s_1}\\ \textsc{conds}\ \boxed{c_1}\end{array}\right]\\ \textsc{dtrs} & \left\langle\left[\textsc{sem}\left[\begin{array}{l}\textsc{subord}\ \boxed{s_2}\\ \textsc{conds}\ \boxed{c_2}\end{array}\right]\right],\ldots,\left[\textsc{sem}\left[\begin{array}{l}\textsc{subord}\ \boxed{s_n}\\ \textsc{conds}\ \boxed{c_n}\end{array}\right]\right]\right\rangle\end{array}\right]$$

The semantics of each daughter is appended in the mother node, while the distinguishing labels of the head daughter are identified with the mother's. A similar constraint is used for *head-adjunct* and *head-specifier* constructions (cf. Richter and Sailer (1999) and Copestake et al. (2003) for example).

By adopting Beavers and Sag (2004) we are also able to cope with (27), as NP coordination with determiner ellipsis (as opposed to true N' coordination where other kinds of readings emerge):

(27) Every linguist, logician and philosopher agreed (with each other).

3.2 Underspecified Distributivity

The conjunctive coordination constraint we have proposed introduces an existentially quantified non-atomic referent. This pluralic referent must be able to be interpreted distributively as well as collectively, similarly to what occurs to other kinds of pluralities in general:

(28) a. The students / John and Mary smiled. *(Distributive)*
b. Some lawyers / A man and a woman met in the bar. *(Collective)*

In our account, the verb will interact with a pluralic argument in exactly the same way, whether the NP is a simple plural (e.g. *the students*) or complex (e.g. *John and Mary*). If a verb is distributive as in (28a), it will simply force a distributive reading of the NP. If collective, as in (28b), the argument can be taken directly.

It is also known that in the case of 'mixed' (or 'neutral') predicates like *hire*, *buy*, and *carry*, both kinds of readings can arise on each argument:

(29) a. Two lawyers/ Jim and Will have hired a detective before. *(C/D)*
b. As far as I know, Sue only hired two lawyers / Tom and Mia. *(C/D)*
c. The kids / Jimmy and Dan took a toy upstairs. *(C/D)*

Note also that pluralities can be simultaneously interpreted collectively and distributively (Massey, 1976; Link, 1984; Dowty, 1986):

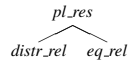
(30) a. The boy and the girl kissing in the park are students. *(C&D)*
b. Some students nodded and gathered around the teacher *(D&C)*
c. The students who failed the exam agreed to meet in the gym. *(D&C)*

To cope with these cases we follow Link (1983), Roberts (1987), Landman (1989), Hendriks (1997), and many others in assuming a distribution operation which can be triggered by predicates with pluralic arguments. Such distribution however, does not prevent other predicates from accessing the plurality referent once again:

(31) John and Mary smiled and kissed.
$\exists^{\mathsf{c}}(\mathsf{Z},\exists(\mathsf{x},\mathsf{J}(\mathsf{x}),\exists(\mathsf{y},\mathsf{M}(\mathsf{y}),\mathsf{x}{\in}\mathsf{Z}\wedge\mathsf{y}{\in}\mathsf{Z})),\forall(\mathsf{k},\mathsf{k}{\in}\mathsf{Z},\mathsf{smile}(\mathsf{e},\mathsf{k}))\wedge\mathsf{kiss}(\mathsf{e}',\mathsf{Z}))$

Following Chaves (2005), verbs lexically introduce a *pl(ural) res(olution)* relation:

(32)
$$\left[\begin{array}{ll}\textsc{label}&\boxed{l}\\ \textsc{rel}&\textit{pl\_res}\\ \textsc{arg1}&\textit{ref-index}\\ \textsc{arg2}&\textit{ref-index}\\ \textsc{scope}&\boxed{l'}\end{array}\right]$$



The type *pl_res* introduces two subtypes, *distr_rel* and *eq_rel*. If *pl_res* is resolved as *eq_rel* then the referents are simply 'equated' (i.e. unified), but if *pl_res* resolved as *distr_rel* then a distributive interpretation is obtained. The two possibilities are captured by the Plural Resolution constraint given below:

(33)
$$\left[\text{REL} \quad \textit{pl\_res}\right] \Rightarrow \begin{bmatrix} \text{REL} & \textit{eq\_rel} \\ \text{ARG1} & \boxed{1}\textit{ref-index} \\ \text{ARG2} & \boxed{1} \end{bmatrix} \vee \begin{bmatrix} \text{REL} & \textit{distr\_rel} \\ \text{ARG1} & \textit{ref-index} \\ \text{ARG2} & \textit{non-at} \end{bmatrix}$$

In order to allow semantic representations to be underspecified in respect to plural as well as scope ambiguities, we view the application of this constraint as 'delayed', on a par with scope disambiguation. This can be implemented in different ways, for instance with a delaying function (cf. *pl_dis* in Frank and Reyle (1995)), with a persistent default constraint, or as an optional processing constraint.

Take for instance the past tense of a distributive verb such as *smile*, *snore* or *die*, which is compatible with plural and singular subjects alike:

(34) A dog and a cat / Some patients / Every plant / Kenny died.

$$\left\langle \textit{died}, \begin{bmatrix} \text{ARG-ST} \left\langle \text{NP}: \begin{bmatrix} \text{INDEX} & \boxed{1} \\ \text{LS} \mid \text{L-MIN} & \boxed{l1} \end{bmatrix} \right\rangle \\ \text{SEM} \begin{bmatrix} \text{INDEX} \boxed{e} \\ \text{LS} \begin{bmatrix} \text{L-MAX} \boxed{l4} \\ \text{L-MIN} \boxed{l3} \end{bmatrix} \\ \text{SUBORD} \left\langle \boxed{l4} = \boxed{l1}, \boxed{l3} \leq \boxed{l5} \right\rangle \\ \text{CONDS} \left\langle \begin{bmatrix} \text{LABEL} & \boxed{l4} \\ \text{REL} & \textit{pl\_res} \\ \text{ARG1} & \boxed{3} \\ \text{ARG2} & \boxed{1} \\ \text{SCOPE} & \boxed{l5} \end{bmatrix}, \begin{bmatrix} \text{LABEL} & \boxed{l3} \\ \text{REL} & \textit{die} \\ \text{ARG0} & \boxed{e} \\ \text{ARG1} & \boxed{3}\textit{at} \end{bmatrix} \right\rangle \end{bmatrix} \end{bmatrix} \right\rangle$$

The above lexical entry is able to account for all the possible subjects. While no constraints are imposed on the NP, the predicate argument $\boxed{3}$ is typed as *at(omic)*. This means that no collective readings are allowed. If $\boxed{1}$ is an atomic referent (as in 'Kenny' or 'every plant') then the signature in (33) forces the non-distributive *eq_rel* resolution, unifying $\boxed{1}$ and $\boxed{3}$. This is the only possible solution because the *distr_rel* disjunct in (33) is restricted to distribute over non-atomic referents only. The distributive relation is interpreted as seen below:[6]

(35)
$$\begin{bmatrix} \text{LABEL} & \boxed{l} \\ \text{REL} & \textit{distr\_rel} \\ \text{ARG1} & \boxed{\alpha} \\ \text{ARG2} & \boxed{X}\textit{non-at} \\ \text{SCOPE} & \boxed{l'} \end{bmatrix} \quad \equiv \quad l: \frac{\boxed{\alpha}}{\boxed{\alpha \in X}} \Rightarrow \boxed{l'}$$

If $\boxed{1}$ is non-atomic (as in 'some patients' or 'Jim and Sue') then the typing in $\boxed{3}$*at* and the constraint in (33) force a distributive disambiguation. The non-distributive resolution *eq_rel* is not possible because the types *at* and *non-at* do not unify.

[6]Capitalized characters stand for non-atomic referents, non-capitalized characters for atomic ones, and greek characters for referents that can be either.

Note that the verbal predicate of the lexical entry in (34) is weakly subordinate to the plural resolution ($l_3 \leq l_5$). This allows to capture scope ambiguities in distributive resolutions. Adjunct outscope the head l_3 but remain underspecified relatively to the distribution. For instance, due to traffic jams:

(36) ... some patients died in an ambulance (on the way to a hospital).

a. $\exists(y, \text{ambulance}(y), \exists(X, \text{patients}(X), \forall(k, k \in X, \text{die}(e, k) \wedge \text{in}(e, y))))$
b. $\exists(X, \text{patients}(X), \forall(k, k \in X, \exists(y, \text{ambulance}(y), \text{die}(e, k) \wedge \text{in}(e, y))))$

This technique thus allows to decouple scope and plural underspecification. For distributive verbs bearing plural inflection (e.g. 'The students smile' vs. '*John smile') one uses the type *distr_rel* in the lexical entry instead of using *pl_res*.

Mixed predicates present an interesting case because these can yield collective or distributive readings on each of the NP arguments as seen in (29). We capture this fact with a single underspecified lexical entry, in relation on both arguments:

(37)
$$\left\langle \textit{hired}, \begin{bmatrix} \text{ARG-ST} \left\langle \text{NP}: \begin{bmatrix} \text{INDEX} & \boxed{1} \\ \text{LS} \mid \text{L-MIN} & \boxed{l3} \end{bmatrix}, \text{NP}: \begin{bmatrix} \text{INDEX} & \boxed{2} \\ \text{LS} \mid \text{L-MIN} & \boxed{l8} \end{bmatrix} \right\rangle \\ \text{SEM} \begin{bmatrix} \text{LS} \mid \text{L-MIN} \boxed{l} \\ \text{SUBORD} \left\langle \boxed{l4} = \boxed{l3}, \boxed{l} \leq \boxed{l5}, \boxed{l9} = \boxed{l8}, \boxed{l} \leq \boxed{l10} \right\rangle \\ \text{CONDS} \left\langle \begin{bmatrix} \text{LABEL} & \boxed{l4} \\ \text{REL} & \textit{pl\_res} \\ \text{ARG1} & \boxed{3} \\ \text{ARG2} & \boxed{1} \\ \text{SCOPE} & \boxed{l5} \end{bmatrix}, \begin{bmatrix} \text{LABEL} & \boxed{l9} \\ \text{REL} & \textit{pl\_res} \\ \text{ARG1} & \boxed{4} \\ \text{ARG2} & \boxed{2} \\ \text{SCOPE} & \boxed{l10} \end{bmatrix}, \begin{bmatrix} \text{LABEL} & \boxed{l} \\ \text{REL} & \textit{hire} \\ \text{ARG1} & \boxed{3} \\ \text{ARG2} & \boxed{4} \end{bmatrix} \right\rangle \end{bmatrix} \end{bmatrix} \right\rangle$$

As before, the above lexical entry is underspecified in the sense that both argument NPs can be singular or plural, and take wide or narrow scope over the predicate. However, no constraint is now placed on the arguments of the predicate, as these may be atomic or not. Take for example a simple plural subject in sentence (38), and the respective underspecified representation:

(38) Some lawyers hired a secretary.

$$\begin{bmatrix} \text{SUBORD} \left\langle \boxed{l4} = \boxed{l3}, \boxed{l} \leq \boxed{l5}, \boxed{l9} = \boxed{l8}, \boxed{l} \leq \boxed{l10} \right\rangle \\ \text{CONDS} \left\langle \begin{bmatrix} \text{LABEL} & \boxed{l1} \\ \text{REL} & \textit{some} \\ \text{DREF} & \boxed{1}\textit{non-at} \\ \text{RES} & \boxed{l2} \\ \text{SCOPE} & \boxed{l3} \end{bmatrix}, \begin{bmatrix} \text{LABEL} & \boxed{l2} \\ \text{REL} & \textit{lawyers} \\ \text{DREF} & \boxed{1} \end{bmatrix}, \begin{bmatrix} \text{LABEL} & \boxed{l6} \\ \text{REL} & \textit{a} \\ \text{DREF} & \boxed{2}\textit{at} \\ \text{RES} & \boxed{l7} \\ \text{SCOPE} & \boxed{l8} \end{bmatrix}, \begin{bmatrix} \text{LABEL} & \boxed{l7} \\ \text{REL} & \textit{secretary} \\ \text{DREF} & \boxed{2} \end{bmatrix}, \right. \\ \left. \begin{bmatrix} \text{LABEL} & \boxed{l4} \\ \text{REL} & \textit{pl\_res} \\ \text{ARG1} & \boxed{3} \\ \text{ARG2} & \boxed{1} \\ \text{SCOPE} & \boxed{l5} \end{bmatrix}, \begin{bmatrix} \text{LABEL} & \boxed{l9} \\ \text{REL} & \textit{pl\_res} \\ \text{ARG1} & \boxed{4} \\ \text{ARG2} & \boxed{2} \\ \text{SCOPE} & \boxed{l10} \end{bmatrix}, \begin{bmatrix} \text{LABEL} & \boxed{l} \\ \text{REL} & \textit{hire} \\ \text{ARG0} & \boxed{e} \\ \text{ARG1} & \boxed{3} \\ \text{ARG2} & \boxed{4} \end{bmatrix} \right\rangle \end{bmatrix}$$

In the above representation, scope remains underspecified and the interpretation of the plural subject is still unresolved. A distributive reading is obtained in case the Plural Resolution Principle in (33) further instantiates the *pl_res* relation labeled by l_4 as a distribution:

(39)
$$\left[\begin{array}{l}\text{SUBORD}\ \langle \boxed{l4}=\boxed{l3}, \boxed{l}\leq\boxed{l5}, \boxed{l9}=\boxed{l8}, \boxed{l}\leq\boxed{l10}\rangle \\ \text{CONDS}\left\langle \begin{bmatrix}\text{LABEL}\ \boxed{l1}\\ \text{REL}\ \textit{some}\\ \text{DREF}\ \boxed{1}\textit{non-at}\\ \text{RES}\ \boxed{l2}\\ \text{SCOPE}\ \boxed{l3}\end{bmatrix}, \begin{bmatrix}\text{LABEL}\ \boxed{l2}\\ \text{REL}\ \textit{lawyers}\\ \text{DREF}\ \boxed{1}\end{bmatrix}, \begin{bmatrix}\text{LABEL}\ \boxed{l6}\\ \text{REL}\ \textit{a}\\ \text{DREF}\ \boxed{2}\textit{at}\\ \text{RES}\ \boxed{l7}\\ \text{SCOPE}\ \boxed{l8}\end{bmatrix}, \begin{bmatrix}\text{LABEL}\ \boxed{l7}\\ \text{REL}\ \textit{secretary}\\ \text{DREF}\ \boxed{2}\end{bmatrix}, \right. \\ \left. \begin{bmatrix}\text{LABEL}\ \boxed{l4}\\ \text{REL}\ \textit{distr\_rel}\\ \text{ARG1}\ \boxed{3}\\ \text{ARG2}\ \boxed{1}\\ \text{SCOPE}\ \boxed{l5}\end{bmatrix}, \begin{bmatrix}\text{LABEL}\ \boxed{l9}\\ \text{REL}\ \textit{eq\_rel}\\ \text{ARG1}\ \boxed{4}\\ \text{ARG2}\ \boxed{2}\\ \text{SCOPE}\ \boxed{l10}\end{bmatrix}, \begin{bmatrix}\text{LABEL}\ \boxed{l}\\ \text{REL}\ \textit{hire}\\ \text{ARG0}\ \boxed{e}\\ \text{ARG1}\ \boxed{3}\\ \text{ARG2}\ \boxed{4}\end{bmatrix} \right\rangle \end{array}\right]$$

Since the semantic representation is still scopally underspecified, the indefinite can have a wide or narrow scope relative to the distribution. The typing *at(omic)* of the complement NP 'a secretary' forces it to be resolved non-distributively as *eq_rel*, regardless of how the subject is resolved, since that is the only resolution consistent with the constraints in (33).

Conversely, the collective reading obtains if *pl_res* is resolved as *eq_rel*:

(40)
$$\left[\begin{array}{l}\text{SUBORD}\ \langle \boxed{l4}=\boxed{l3}, \boxed{l}\leq\boxed{l5}, \boxed{l9}=\boxed{l8}, \boxed{l}\leq\boxed{l10}\rangle \\ \text{CONDS}\left\langle \begin{bmatrix}\text{LABEL}\ \boxed{l1}\\ \text{REL}\ \textit{some}\\ \text{DREF}\ \boxed{1}\textit{non-at}\\ \text{RES}\ \boxed{l2}\\ \text{SCOPE}\ \boxed{l3}\end{bmatrix}, \begin{bmatrix}\text{LABEL}\ \boxed{l2}\\ \text{REL}\ \textit{lawyers}\\ \text{DREF}\ \boxed{1}\end{bmatrix}, \begin{bmatrix}\text{LABEL}\ \boxed{l6}\\ \text{REL}\ \textit{a}\\ \text{DREF}\ \boxed{2}\textit{at}\\ \text{RES}\ \boxed{l7}\\ \text{SCOPE}\ \boxed{l8}\end{bmatrix}, \begin{bmatrix}\text{LABEL}\ \boxed{l7}\\ \text{REL}\ \textit{secretary}\\ \text{DREF}\ \boxed{2}\end{bmatrix}, \right. \\ \left. \begin{bmatrix}\text{LABEL}\ \boxed{l4}\\ \text{REL}\ \textit{eq\_rel}\\ \text{ARG1}\ \boxed{3}\\ \text{ARG2}\ \boxed{1}\\ \text{SCOPE}\ \boxed{l5}\end{bmatrix}, \begin{bmatrix}\text{LABEL}\ \boxed{l9}\\ \text{REL}\ \textit{eq\_rel}\\ \text{ARG1}\ \boxed{4}\\ \text{ARG2}\ \boxed{2}\\ \text{SCOPE}\ \boxed{l10}\end{bmatrix}, \begin{bmatrix}\text{LABEL}\ \boxed{l}\\ \text{REL}\ \textit{hire}\\ \text{ARG0}\ \boxed{e}\\ \text{ARG1}\ \boxed{3}\\ \text{ARG2}\ \boxed{4}\end{bmatrix} \right\rangle \end{array}\right]$$

Our proposal thus decouples scope interactions from plural interpretation by locating the collective/distributive potential in the lexical entry of predicates. This is desirable since a NP can simultaneously be interpreted collectively and distributively without altering the possible scopal ambiguities that arise in relation to other arguments (Hoeksema 1983; Dowty 1986; Roberts 1987:121-122):

(41) a. The boys met at the pub and had a beer.
b. Some kids gathered around her, closed their eyes, and made a wish.
c. The kids surrounded the magician and thought of a number.

Verbal conjuncts remain scopally separate given that the respective *pl_res* relations are lexically merged to the nominal DRSs (given that collective verbs can also distribute, see §3.4 (52)). Also, we believe VP coordination does not establish a scope island, as generalized quantifiers are able to outscope an external argument:[7]

(42) a. The White House is very careful about this. An official representative will personally read each document and reply to every letter.
b. We had to do this ourselves. By the end of the year, some student had proof-read every document and corrected each theorem.

In relative clauses, we assume that these can attach to full NPs and access the restrictor label of the modified NP, so that the relativized argument is semantically identified with the restrictor (e.g. NP[RESTR $\boxed{1}$] and RelC[MOD|L-MIN $\boxed{1}$]).[8]

3.3 Reciprocal Anaphora

Reciprocals like *each other* are often seen as second-order operators that yield pairs of distinct, universally quantified referents. Instead of redefining our notions of subcategorization and variable binding entirely, we follow Heim et al. (1991) and propose an alternative account where reciprocals are regular arguments.

In van der Sant (1992) anaphora are processed in the semantics, through accommodation and resolution. Inspired by this insight, we suggest that *each other* introduces two anaphoric referents which must be locally accommodated and bound, W and α below, as well as a series of semantic conditions:

(43) l_1:

$W \quad \alpha$
W = ...
α = ...
$\alpha \in W$
β / $\beta \in W$, $\beta \neq \alpha$ $\Rightarrow$ l_2

The above conditions force a distributive reading of the binder of W, by also requiring that a member α be locally accessible. The distribution over members distinct from α interacts with the distribution of the binder of W, yielding reciprocation:

(44) The boys hate each other.

$\exists(X, \mathsf{boys}(X), \forall(k, k{\in}X, l_1))$ $\quad$ $\exists(W, W{=}..., \exists(z, z{=}...{\wedge}z{\in}W \wedge \forall(w, w{\in}W \wedge w{\neq}z, l_2)))$

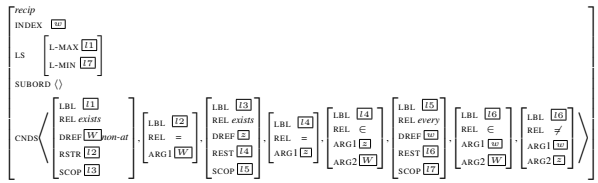
l_3: $\mathsf{hate}(e, k, w)$

A plural local o-commander will be the binder for W, taking wide scope. A binder for α is found under the scope of the distribution introduced by the verb:

[7] I owe these examples to Ivan Sag (p.c.).
[8] For scope islands for generalized quantifiers see the feature TOP in Chaves (2002).

(45) $\exists(\mathsf{X}, \mathsf{boys}(\mathsf{X}), \forall(\mathsf{k}, \mathsf{k}{\in}X,$
$\exists(\mathsf{W}, \mathsf{W}{=}\mathsf{X}, \exists(\mathsf{z}, \mathsf{z}{=}\mathsf{k} \wedge \mathsf{z}{\in}\mathsf{W} \wedge \forall(\mathsf{w}, \mathsf{w}{\in}\mathsf{W} \wedge \mathsf{w}{\neq}\mathsf{z}, \mathsf{hate}(\mathsf{e}, \mathsf{k}, \mathsf{w}))))))$

The verb predicate needs only to access the main discourse referent w, just like in other argument NPs. Different conditions might be adopted to cope with well-known vagueness effects of reciprocity (see Dalrymple et al. (1998)). This approach works similarly for mixed predicates and reciprocal transitive collectives, by forcing a distributive reading of the binder. The AVM corresponding to (43) is:



Since this a semantic-based approach, it is necessary to reformulate HPSG's Binding Theory in order to allow the interleaving of accommodation constraints and o-command constraints. We cannot pursue this issue presently, and will raise the suggestion that Principle A be extended so that locally o-commanded *recip* pronouns have the respective '=' binding restrictions locally accommodated and bound.

Note that wide or narrow scope of set-formation in 'every man and every woman hate each other' yields *all-on-all* or *pair* reciprocal readings respectively. For instance, in the hydra in (46) the distribution outscoping the reciprocal is triggered by *pl_res* of the distributive verb *hate* (below, $\mathsf{recip}(\mathsf{w}, \ldots)$ abbreviates (43)):

(46) Every gangster and every drug dealer who hate each other argued.
$\forall(\mathsf{x}, \mathsf{gangster}(\mathsf{x}), \forall(\mathsf{y}, \mathsf{drugdealer}(\mathsf{y}),$
$\exists^{\mathsf{c}}(\mathsf{Z},\ \mathsf{x} \in \mathsf{Z} \wedge \mathsf{y} \in \mathsf{Z} \wedge \forall(\mathsf{k}, \mathsf{k} \in \mathsf{Z}, \mathsf{recip}(\mathsf{w}, \mathsf{hate}(\mathsf{e}, \mathsf{k}, \mathsf{w}))),\ \mathsf{argue}(\mathsf{e}', \mathsf{Z}))))$

In this reading, the gangsters that hate mobsters (and vice-versa) argued. Other difficult cases like the one below can also be captured:

(47) The linguists quoted each other's paper.
$\exists(\mathsf{X}, \mathsf{linguists}(\mathsf{X}), \forall(\mathsf{k}, \mathsf{k} \in \mathsf{X}, \exists(\mathsf{y}, \mathsf{paper}(\mathsf{y}) \wedge \mathsf{recip}(\mathsf{w}, \mathsf{of}(\mathsf{y}, \mathsf{w})), \mathsf{quote}(\mathsf{e}, \mathsf{k}, \mathsf{y}))))$

Higginbotham (1980) and others note an ambiguity in (48), where either John and Mary think to be in love with each other, or each thinks himself in love:

(48) John and Mary think they love each other.

We disagree that this effect is due to *each other*, since the same readings arise without the reciprocal. Like (48), (49) has a second reading where each individual thinks himself to be smart (a *de se* reading of *they* in indirect discourse):

(49) John and Mary think they are smart.

3.4 Intermediate Level Readings

Kamp and Reyle (1993) adopt a lattice-theoretical model theory for plurals, based in Link's mereologic logic, originally intended as a first-order account of pluralities. Link (1984) raises several objections against using sets and higher-order logic to represent plurals, most of which are philosophical, but one which is semantic: using sets leads to the wrong predictions such as the truth of (50) below.

(50) Peter, Paul, and Mary have three elements.

We reject this argument because it seems to mix natural language with metalanguage (see Lønning (1997:1050)).[9] However Link (1998a) shows that his logical framework is actually powerful enough to represent second-order sentences. The mereology account is further complicated by additional operations such as group formation (Hoeksema, 1983; Link, 1984; Landman, 1989) or second-order *cover* operators (Gillon, 1987; Schwarzschild, 1990), required to deal with intermediate-level readings of well-known examples like the ones seen in (51):

(51) a. The boys and the girls were separated.
b. [Blücher] and [Napoleon and Wellington] fought against each other.
c. The boys and the girls got $10.000 for the match.
d. The landlords and the tenants who hate each other argued endlessly.

The above can be interpreted distributively over the conjunct members or over the collection of atomic individuals (e.g. separating boys from girls vs. separating kids). The group approach can become formally very complex and somewhat redundant (Landman 1989; Krifka 1991; Landman 2000:162-164). For instance Link (1998b:30) notes that in Landman's system, iterative group formation generates a structure with $2^{33\,000}$ nodes out of just 4 base atom types. Type-shifting operations over the nodes of such vast lattices only make matters worse. We believe that the domain should allow processing to be computationally tractable for psycholinguistic plausibility reasons: when someone utters a sentence about most, few or all of the books and magazines on a shelf, no cognitive pitfall is apparent. Similar problems have been raised concerning the various proposals of covers and partitions, criticized in Lønning (1991), Krifka (1991), and Lasersohn (1995:132-141) for their linguistic inadequacy and/or their combinatorial explosion of readings.

Since we have adopted set-formation, we can capture the two kinds of distributivity required for (51) straightforwardly. In intermediate readings, our distributive relation with '$\in$' picks up the immediate members of a (simple or complex) non-atomic referent. In full distributive readings the complex plurality Z is reinterpreted as a standard flat sum of atomic individuals, so that the distribution relation can now distribute over the individuals. Similarly for collective verbs:

(52) The boys and the girls gathered outside.

[9] The argument would also apply to Link's sums: 'Peter, Paul, and Mary have three parts.'

In an intermediate reading one only needs to distribute over members of Z, and in a collective reading one takes the sum of the atomic individuals in Z. There seems to exist no reason to interpret Z directly in the model, with a higher-order entity. We can view variables quantified by $\exists^{c}$ as mere temporary stores for the extensions of the conjuncts, construed via membership '$\in$' to Z. Krifka (1991) proposes a similar move in DRT, using meta-variables in the discourse level. Set-formation can also be ordered (via dynamic sets or a partial order relation), to deal with *respectively* readings without complicating the modeling structures (e.g. as in group formation in Link (1984)). Thus 'set' formation does not force us to commit to higher-order logic. However if one is inclined to do so, one may adopt generalized models and recast a second-order setting into a many-sorted first-order logic (cf. van Benthem and Doets (1983) and Lønning (1997:1020–1028)). Here, contextually restricted pluralities can be provided by the model so that one may use bounded (or guarded) fragments to avoid the problems caused by quantifying over arbitrary entities. See van Benthem (2005) for recent formal results.

4 Conclusion

This paper proposes a uniform and compositional analysis of pluralites, with particular focus on NP coordination. We consider distributive and collective readings, as well as scope ambiguities and anaphora. It is shown how the interaction between NP conjuncts can capture different plural readings in reciprocal environments. Underspecification techniques are used to cope with plural and scope ambiguities efficiently, in a DRT/HPSG interface based in Frank and Reyle (1995).

References

Alshawi, Hiyan and Crouch, Richard. 1992. Monotonic Semantic Interpretation. In *Proceedings of the 30th ACL*, pages 32–39, Newark, NJ.

Babko-Malaya, Olga. 2004. LTAG Semantics of NP-Coordination. In *TAG+7: Seventh International Workshop on Tree Adjoining Grammar and Related Formalisms*, pages 111–117, Vancouver, BC, Canada.

Barwise, John. 1979. On branching quantifiers in English. *Journal of Philosophical Logic* 8, 47–80.

Beavers, John and Sag, Ivan A. 2004. Ellipsis and Apparent Non-Constituent Coordination. In Stefan Müller (ed.), *HPSG-2004, Katholieke Universiteit Leuven*, pages 48–69, Stanford: CSLI Publications.

van Benthem, Johan. 2005. *Guards, Bounds and Generalized Semantics*. Preprint PP-2005-7, Institute for Logic, Language and Computation, University of Amsterdam. To appear in *Journal of Logic, Language and Information, special issue on guarded fragments*, Natasha Alechina (ed.).

van Benthem, Johan and Doets, Kees. 1983. Higher-order Logic. In D. Gabbay and F. Guenthner (eds.), *Handbook of Philosophical Logic, vol. I.*, pages 275 – 329, Reidel, Dordrecht.

Bos, Johan. 1996. Predicate Logic Unplugged. In *Proceedings of the 10th Amsterdam colloquium*, pages 133–142, Amsterdam.

Bos, Johan. 1999. The Treatment of Focusing Particles in Underspecified Discourse Representations. In P. Bosh and R. van der Sandt (eds.), *Focus - Linguistic, Cognitive and Computational Perspectives*, pages 121–141, Cambridge: Cambridge University Press.

Carpenter, Bob. 1997. *Type-Logical Semantics*. The MIT Press: Cambridge, Mass.

Chaves, Rui P. 2002. Principle-Based DRTU for HPSG: a case study. In *Proceedings of the First International Workshop on Scalable Natural Language Understanding, SCANALU 2002*, EML, Heidelberg.

Chaves, Rui P. 2003. Non-Redundant Scope Disambiguation in Underspecified Semantics. In Balder ten Cate (ed.), *Proceedings of the 8th ESSLLI Student Session*, pages 47–58, ESSLLI 2003, Vienna, Austria.

Chaves, Rui P. 2005. DRT and Underspecification of Plural Ambiguities. In Harry Bunt, Jeroen Geertzen and Elias Thijse (eds.), *Proceedings of the 6th IWCS*, pages 78–89, Tilburg, The Netherlands.

Copestake, Ann, Flickinger, Dan, Malouf, Rob, Riehemann, Susanne and Sag, Ivan. 1995. Translation using Minimal Recursion Semantics. In *Proceedings of The Sixth TMI-95*, Leuven, Belgium.

Copestake, Ann, Flickinger, Daniel, Sag, Ivan and Pollard, Carl. 2003. Minimal Recursion Semantics: An Introduction, ms. Stanford (*Under review*).

Dalrymple, Mary, Kanazawa, Makoto, Kim, Yookyung, Mchombo, Sam and Peters, Stanley. 1998. Reciprocal expressions and the concept of reciprocity. *Linguistics and Philosophy* 21, 159–210.

Dik, Simon C. 1968. *Coordination: Its Implications for the Theory of General Linguistics*. North-Holland, Amsterdam.

Dowty, David. 1986. Collective predicates, distributive predicates and *all*. In *Proceedings of the Easter States Conference on Linguistics, ESCOL3*, Cascadilla.

Egg, Markus, Niehren, Joachim and Koller, Alexander. 2001. The Constraint Language for Lambda Structures. *Journal of Logic, Language, and Information* 10, 457–485.

Frank, Anette and Reyle, Uwe. 1995. Principle Based Semantics for HPSG. In *Proceedings of the 6th Meeting of the ACL*, European Chapter, Dublin.

Gillon, Brendan. 1987. The Readings of Plural Noun Phrases in English. *Linguistics and Philosophy* 10, 199–219.

Heim, Irene, Howard Lasnik, and Robert May. 1991. Reciprocity and plurality. *Linguistic Inquiry* 22, 63–101.

Hendriks, Herman. 1997. *Studied Flexibility: Categories and Types in Syntax and Semantics*. Ph.D. dissertation, University of Amsterdam.

Higginbotham, James. 1980. Reciprocal Interpretation. *Journal of Linguisitc Research* 1(3), 97–117.

Hoeksema, Jack. 1983. Plurality and Conjunction. In A. G. B. ter Meulen (ed.), *Studies in Modeltheoretic Semantics*, pages 63–106, Foris, Dordrecht.

Hoeksema, Jack. 1988. The semantics of non-Boolean *and*. *Journal of Semantics* 6, 16–40.

Kallmeyer, Laura and Joshi, Aravind. 2003. Factoring Predicate Argument and Scope Semantics: Underspecified Semantics with LTAG. *Research on Language and Computation* 1(1-2), 3–58.

Kamp, Hans and Reyle, Uwe. 1993. *From Discourse to Logic*. Dordrecht, Holland: Kluwer.

Krifka, Manfred. 1991. How to get rid of groups, using DRT. In *Texas Linguistic Forum 32*, pages 71–110, also in *Proceedings of the Third Symposium on Logic and Language* (1990), Revfülöp, Dordrecht, Reidel.

Lakoff, G. and Peters, S. 1969. Phrasal Conjunction and Symmetric predicates. In D. Reibel and S. Schane (eds.), *Modern studies in English: Readings in Transformational Grammar*, Englewood Cliffs, NJ: Prentice Hall.

Landman, Fred. 1989. Groups, Part I. *Linguistics and Philosophy* 12, 559–605.

Landman, Fred. 2000. *Events and Plurality: the Jerusalem Lectures*. Dordrecht: Kluwer Academic Publishers.

Lasersohn, Peter. 1995. *Plurality, Conjunction and Events*. Kluwer: Dordrecht.

Link, Godehard. 1983. The logical analysis of plurals and mass terms: a lattice-theoretical approach. In R. Bäuerle, C. Schwarze and A. von Stechow (eds.), *Meaning, Use and Interpretation of Language*, pages 302–323, Berlin: de Gruyter.

Link, Godehard. 1984. Hydras: on the logic of relative clause constructions with multiple heads. In F. Landman and F. Veltman (eds.), *Varieties of Formal Semantics*, pages 245–257, Dordrecht: Foris.

Link, Godehard. 1998a. First Order Axioms for the Logic of Plurality. In *Algebraic Semantics in Language and Philosophy*, pages 133–156, CSLI Notes No. 74.

Link, Godehard. 1998b. Ten Years of Research on Plurals - Where Do We Stand? In Fritz Hamm and Erhard Hinrichs (eds.), *Plurality and Quantification*, Studies in Linguistics and Philosophy, pages 19–54, Kluwer academic publishers.

Lønning, Jan Tore. 1989. *Some Aspects of the Logic of Plural Noun Phrases*. PhD. Dissertation, University of Oslo, Cosmos-Report 11.

Lønning, Jan Tore. 1991. Among Readings. Some Comments on "Among Collections". In *Quantification and Anaphora II*, pages 37–51, Edinburgh: Centre for Cognitive Science, University of Edinburgh, DYANA Deliverable 2.2.b.

Lønning, Jan Tore. 1997. Plurals and Collectivity. In J. van Benthem *et al.* (ed.), *Handbook of Logic and Language*, pages 1009–1053, Elsevier: Elsevier.

Massey, Gerald. 1976. Tom, Dick and Harry, and all the King's Men. *American Philosophical Quarterly* 13, 89–107.

Pollard, Carl and Sag, Ivan A. 1994. *Head-driven Phrase Structure Grammar*. Chicago University Press, Chicago.

Reyle, Uwe. 1993. Dealing with ambiguities by underspecification: Construction, representation and deduction. *Journal of Semantics* 10(2), 123–179.

Reyle, Uwe. 1996. Co-Indexing Labelled DRSs to Represent and Reason with Ambiguities. In Stanley Peters and Kees van Deemter (eds.), *Semantic Ambiguity and Underspecification CSLI Lecture Notes*, pages 239–268, CSLI: Stanford.

Richter, Frank and Sailer, Manfred. 1999. Underspecified Semantics in HPSG. In Harry Bunt and Reinhard Muskens (eds.), *Computing Meaning*, Studies in Linguistics and Philosophy, pages 95–112, Kluwer academic publishers.

Richter, Frank and Sailer, Manfred. 2001. Polish Negation and Lexical Resource Semantics. In Geert-Jan M. Kruijff, Lawrence S. Moss and Richard T. Oehrle (eds.), *Proceedings of FGMOL 2001*, electronic Notes in Theoretical Computer Science. Volume 53, Elsevier.

Roberts, Craige. 1987. *Modal Subordination, Anaphora and Distributivity*. Ph.D. thesis, University of Massachusetts at Amherst.

van der Sandt, Rob. 1992. Presupposition projection as anaphora resolution. In *Journal of Semantics*, volume 9, pages 333–377.

Schwarzschild, Roger. 1990. Against Groups. In Martin Stokhof and Leen Torenvliet (eds.), *Proceedings of the Seventh Amsterdam Colloquium*, pages 475–494.

Evaluative adverbs and underspecified semantic representations

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Abstract

We show that French evaluative adverbs such as *heureusement* 'fortunately', *bizarrement* 'oddly' present two challenges at the syntax-semantics interface: they take their scope outside of the main semantic content, and they do not respect resource sensitivity. Potts (2005) adresses these two issues, but fails to account for the special illocutionary force of evaluatives and their semantic embeddability. We propose an explicit analysis within an HPSG grammar, and propose a modification of MRS (Copestake et al., 2003) that addresses the peculiar status of evaluatives in semantic composition.

1 Evaluative adverbs as a challenge to compositionality

Evaluative adverbs belong to the class of parenthetical adverbs, together with speech act adverbs (e.g. *honnêtement* 'honestly'), agentive adverbs (so-called 'subject oriented', e.g. *gentiment* 'kindly'), and connectives (e.g. *donc* 'therefore'). Parenthetical expressions are constituents whose semantic contribution does not get inserted in the main semantic content. Rather, they provide some sort of comment on either (part of) the content of the clause or the speech act as a whole. In the case of evaluative adverbs, this is shown clearly by examples such as (1) and (2). In (1a), where the adverb occurs inside the antecedent of a conditional, it is intuitively clear that the presence of the adverb does not modify what condition is expressed; compare (1b), where the quasi-synonymous evaluative adjective has a quite different effect. In (2a), the adverb occurs inside a question, but it does not provide a part of the query. Rather it makes a comment on the open proposition the question is built upon.

(1) a. Si Paul va, malheureusement, voir Marie, elle sera furieuse.
'If, unfortunately, Paul goes and sees Marie, she will be furious.'

b. S'il est malheureux que Paul ait vu Marie, il est tragique qu'il l'ait insultée.
'If, it is unfortunate that Paul met Marie, it is tragic that he insulted her.'

(2) a. Qui Marie a-t-elle malheureusement invité ?
asks: who did Marie invite?
commits the speaker to: Whoever Marie invited, it is unfortunate that she did.

b. Qui est-il malheureux que Marie ait invité ?
asks: for which person is it unfortunate that Marie invited that person?

This data suggests that evaluatives have a distinct illocutionary status that sets them apart from ordinary constituents. Modelling this status is a complex issue, and presents two main challenges for a compositional analysis.

A first concern is that the evaluative should not fall within the scope of a sentence's main illocutionary operator. Many authors would suggest, assuming a *principles and parameters* framework, that one just needs to assume that evaluatives are

base-generated in a position to the left of the illocutionary operator, whereas non-parenthetical adverbs are generated to its right. In the present case, this solution will not do, however. At least in French, evaluative adverbs have the exact same distribution as modal adverbs (Bonami et al., 2004). In a typical finite clause, both evaluatives and modals occur in (and only in) the surface positions indicated by bullets in (3). Both types of adverbs can occur only in the position indicated in (3a) with an ordinary, 'integrated' intonation, and both can occur in the larger set of positons indicated in (3b) with a special, 'incidental' intonation (what is often called 'comma intonation').

(3) a. Paul a • envoyé ses vœux à ce vieil ami.
Paul has sent his wishes to this old friend
'Paul sent his best wishes to this old friend of his.'
b. • Paul • a • envoyé • ses vœux • à ce vieil ami •.

But evaluatives and modals have very different semantics: modals contribute to the truth conditions of a sentence, and thus one would definitely not want for the modal to be base-generated to the left of the illocutionary operator.[1] Thus the analysis just suggested would amount to stipulating an unmotivated syntactic distinction for strictly semantic reasons. Moreover, there is a scope interaction between evaluative and modal adverbs, as shown by the contrast in (4). In both examples, the evaluative contributes nothing to the main assertion; but whereas the evaluative in (4a) provides a comment on the proposition that Paul came, the one in (4b) comments on the proposition that Paul *probably* came. Thus (4) suggests that an evaluative scopes over adverbs occurring to its right, despite the fact that the evaluative itself cannot fall in the scope of another adverb.

(4) a. Probablement, Paul est malheureusement venu.
asserts: Paul probably came.
commits the speaker to: If Paul came indeed, it is unfortunate that she did.
b. Malheureusement, Paul est probablement venu.
asserts: Paul probably came.
commits the speaker to: it is unfortunate that Paul probably came.

We conclude that it simply cannot be assumed that there is a fixed scopal relation between the two classes of adverbs, which is not affected by superficial order. Quite on the contrary, the relative scope of the two adverbs is a direct consequence of the surface syntactic configuration.

A second concern is that evaluatives pose a challenge to *resource sensitivity* in the sense of Dalrymple et al. (1993), the constraint that when deriving the semantics of a complex expression, the contribution of each of its parts is used exactly

[1]Note that contrary to what is usually assumed, in the case of adverbs, there is no simple correlation between 'comma intonation' and parenthetical status in the semantic sense.

once. As Potts (2005) notes, the argument of an evaluative serves twice in semantic composition, once as part of the main semantic content, once as the argument of the evaluative. This is problematic for approaches to the syntax-semantics interface which actually rely on resource sensitivity to constrain the output of semantic derivation, and thus calls for special attention.

2 Potts (2005)

In an influential work, Chris Potts suggests that evaluatives are a special case of *conventional implicatures* (CIs), i. e. semantic content that does not contribute to 'what is said', but constitutes an ancillary commitment of the speaker.[2] The formal analysis relies on a version of type-driven translation (Klein and Sag, 1985) with two special features. First, a type distinction is established between 'at-issue' content (basic types e^a, t^a and s^a) and CI content (basic types e^c, t^c and s^c). This distinction is strictly (meaning language) syntactic: a-types and c-types have the same denotation domains, but the type distinction allows one to constrain the way semantic terms are combined. Second, semantic representations are not terms, but parsetrees decorated by terms. Each node in the tree is decorated either by an a-type term or by a pair of an a-type term and a c-type term. Figure 1 shows a plausible analysis for (4a) in this framework. The expression **comma** is a polymorphic type shifting operator $\lambda x \lambda y.x(y)$ which turns at-issue content into CI content.[3] The use of parsetrees as semantic representations allows Potts to dispense with a storage mechanism moving CI content up the tree: the semantics for a sentence is a tuple formed from the root of the parsetree and all CI elements decorating intermediate nodes in the parsetree; for instance the interpretation of the tree in fig. 1 is (5).

(5) $\langle [\![\textbf{probably}(\textbf{come}(\textbf{p}))]\!], [\![\textbf{unfortunately}(\textbf{come}(\textbf{p}))]\!] \rangle$

Although Potts's proposal is very appealing, and is a crucial inspiration for our own analysis, it has two important problems. First, the analysis does not distinguish the illocutionary status of the main content and of the evaluative. Thus one does not see how the analysis will be able to account for the fact that the utterance of an evaluative does not have full assertoric force (a fact that Potts himself notes): a hearer can accept the assertion of e.g. (4a) without being committed to the truth of the evaluative comment, as illustrated by the dialogue in (6).

[2]See Jayez and Rossari (2004) for a very different implementation of the same basic idea. Note that evaluative content differs from presupposed content in at least two major ways: (i) evaluatives are not projected in presupposition hole contexts (see e.g. (1a), (4a)); (ii) an assertion containing an evaluative can be accepted without accepting the evaluative (see example (6) below), whereas a hearer cannot accept an assertion without also accepting its presuppositions.

[3]Note that as the name indicates, Potts takes **comma** to be the semantic exponent of 'comma intonation'. This can't be strictly true, since as observed above, 'comma intonation' is not correlated with parentheticality for adverbs. Thus **comma** has to be a silent type-shifting operator. Note also **comma** is needed because parenthetical adverbs can be modified or quantified over, and Potts sets up its logic so that there are no types $\langle \sigma, \tau \rangle$ where σ is a c-type.

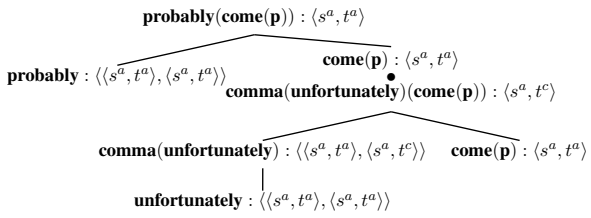


Figure 1: The parsetree for (4a) in Potts's analysis

(6) A: Paul a malheureusement perdu l'élection.
'Paul unfortunately lost the election.'
B: # C'est faux, je trouve que c'est une très bonne nouvelle.
'That's not true, I think it is very good news'.
B: C'est vrai, mais moi, je trouve que c'est une très bonne nouvelle !
'That's true, but I personally think it is great news!'

Second and more importantly, the simplicity of Potts's analysis relies on the assumption that parentheticals always correspond to commitments of the speaker, and cannot be semantically embedded as commitments of another agent. (Potts, 2005, 116–117) insists that this is empirically correct, and that apparent exceptions are really cases where the parenthetical is directly quoted. Although this might be the right analysis for some examples, it cannot be true in a case such as (7). Here the evaluative phrase *malheureusement pour moi* can only convey a comment of Marie, since the speaker explicitly states that he does not agree with that comment; however the phrase cannot be a quotation, since the first person pronoun *moi* refers to the speaker, not Marie.

(7) Marie m'a annoncé que, malheureusement pour moi, je n'avais pas été élu. Je lui ai expliqué que cela m'arrangeait plutôt, vu que je n'avais jamais eu l'intention de prendre le poste.
"Marie announced that, unfortunately for me, I hadn't been elected. I explained that it was fine with me, since I never intended to accept the position."

We thus side with Bach (1999); Geuder (2000); Jayez and Rossari (2004) in recognizing that evaluatives can express commitments of an agent distinct from the speaker, at least in reportive contexts.

To account for these two properties of evaluatives, it seems reasonable to take advantage of the semantic similarity between (implicit) illocutionary operators and (explicit) reportive verbs. We assume that illocutionary operators are part of the semantic content of an utterance (Ginzburg et al., 2001), and that they share with reportive verbs the property of having an extra argument position for ancillary (non-asserted) commitments of the agent. This argument should be set-valued, since a sentence may contain any number of independent evaluatives, starting from zero.[4] When an evaluative is embedded in reported speech, it may correspond either to a commitment of the speaker or to commitments of the agent whose speech is reported. But this means that Potts's way of dealing with CI meaning won't work for evaluatives: it is not adequate to just leave evaluative content embedded in the parsetree, and assume a global collection of all evaluative content as commitments of the speaker. An obvious but inelegant solution to this problem would be to augment Potts's framework with a storage mechanism. In the remainder of this paper we show that explicit storage can be avoided by making use of a more elaborate view of the syntax-semantics interface.

3 Modelling French adverbs in MRS

In the remainder of this paper we provide an explicit analysis of French evaluative adverbs. We take as our starting point the analysis of the syntax and syntax-semantics interface for French adverbs, presented in Bonami and Godard (2003). This analysis is couched in HPSG (Pollard and Sag, 1994) and uses MRS (Copestake et al., 2003) for semantic representations. The use of an underspecified semantics formalism is crucial to accounting for the order-scope correlations we observe within a surface-oriented grammar.

This section presents relevant aspects of MRS, and sketches the general analysis of Bonami and Godard (2003). The next section shows what modifications must be made to accomodate evaluative adverbs within the current framework.

Minimal Recursion Semantics is a framework for the underspecification of scope relations. Informally, an MRS is a collection of tree chunks decorated by terms, where dominance in the tree represents functor-argument relations. The collection of readings associated with an MRS is the collection of complete trees which can be obtained by combining all and only the chunks provided by the MRS; the process of combining tree chunks to arrive at a fully specified semantic representation is called *resolution*.

Figure 2 is a graphical depiction of the MRS one would associate with (8). Boxed integers represent *handles*. Each semantic term carries a handle (its *label*) and may take other handles as arguments. The circled handle is the *global top*, and is constrained to be the root of the tree in a resolved MRS. Plain lines represent direct functor-argument relations, and dotted lines represent *handle constraints* limiting dominance relations between handles—for instance, fig. 2 states that 6 must either be identical to 7 or dominate it. Figure 3 presents the two possi-

[4] These three-argument illocutionary predicates can then be analyzed as contributing a series of dialogue gameboard operations in the sense of (Ginzburg, to appear); see Bonami and Godard (2005) for a proposal in this direction.

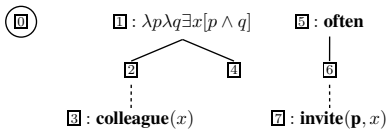


Figure 2: The MRS for (8)

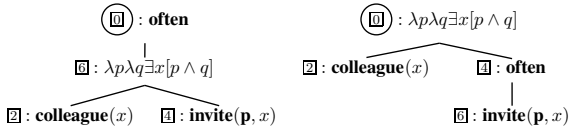


Figure 3: Resolutions for the MRS in fig. 2

ble resolutions of the MRS in fig. 2, corresponding to the two readings of (8). Note that all handle constraints are respected.

(8) Souvent, Paul invite un collègue.
'Paul often invites a colleague.'
a. $\mathbf{often}(\exists x[\mathbf{colleague}(x) \wedge \mathbf{invite}(\mathbf{p}, x)])$
b. $\exists x[\mathbf{colleague}(x) \wedge \mathbf{often}(\mathbf{invite}(\mathbf{p}, x))]$

The MRS formalism in itself is completely agnostic as to the semantic representation language to which the terms decorating the tree nodes belong. It is customary in presentations of MRS and in computational applications to use a variant of first order logic with generalized quantifiers, but nothing precludes using a richer language. For the purposes of this paper we assume a typed language, but do not commit ourselves to a particular ontology because it would take us to far afield to justify it.[5] In some cases we use lambda-terms for convenience, to highlight the intended semantic type of a term. This should not however be taken to imply that lambda-abstraction plays any non-trivial role in our analysis: as is standard in MRS, semantic composition relies entirely on function application as represented by dominance in the trees.

Likewise, MRS is not dependent on a particular grammatical framework; but it has mostly been used as the semantic component for HPSG grammars. Here we as-

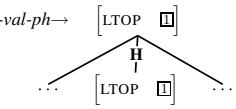
[5]Note in particular that we implicitly treat all adverbs as proposition modifiers, whereas a reasonable ontology would at least distinguish a class of eventuality description modifiers (manner adverbs, degree adverbs, etc.) and proposition modifiers (modals, etc.). This simplification allows us to avoid the explicit representation of temporal and aspectual information. Bonami et al. (2004) and Bonami and Godard (2005) outline a fine-grained classification of adverb types based on the situation-theoretic ontology of Ginzburg and Sag (2000).

sume Bonami and Godard (2003)'s analysis of French adverbs as our starting point. Adverbs outside the VP are analyzed as in Copestake et al. (2003).[6] Semantic composition relies on an auxiliary feature LTOP ('local top'). A word's LTOP is the label (LBL) of its semantic contribution. Adverbs specify that the LTOP of their argument ($\boxed{2}$ in (9a)) must equal or dominate the LTOP of the sign they modify.[7] Whereas head-valence (i.e. head-subject, head-complement or head-specifier) combinations identify their LTOP with that of their head, the LTOP of the phrase is the LTOP of the adjunct in head-adjunct combinations. These constraints ensure that the relative scope of adjuncts is determined by their c-command relations while leaving room for quantifiers to scope between an adjunct and its sister's semantic contribution.

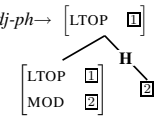
(9) a. Sample adverb entry:

$$\begin{bmatrix} \text{HEAD} & \begin{bmatrix} \textit{adv} & \\ \text{MOD} & \begin{bmatrix} \text{HEAD} & \textit{verb} \\ \text{LTOP} & \boxed{1} \end{bmatrix} \end{bmatrix} \\ \text{RELS} & \left\langle \begin{bmatrix} \textit{adv-rel} & \\ \text{LBL} & \boxed{0} \\ \text{ARG} & \boxed{2} \end{bmatrix} \right\rangle \\ \text{LTOP} & \boxed{0} \\ \text{H-CONS} & \left\langle \left[\boxed{2} =_q \boxed{1} \right] \right\rangle \end{bmatrix}$$

b. *hd-val-ph*→



c. *hd-adj-ph*→



[6]For brevity we ignore the modelling of *incidental* adverbs occurring among complements of the verb, one of the main issues for Bonami and Godard (2003). This is inocuous, since under the analysis presented in (Bonami and Godard, 2003), incidental adverbs are VP-external adverbs which get linearized within the VP by domain union (Reape, 1994). Thus the grammar we present here is merely incomplete, and fully compatible with an explicit account of all occurrences of adverbs in the verbal domain.

[7]Handle constraints are notated using the $=_q$ relation of (Copestake et al., 2003), so-called 'equality modulo quantifiers'. Note that the name is somewhat unfortunate: The $=_q$ relation is really an asymetric relation, and $x =_q y$ means that either $x = y$ or x dominates y. Nothing in the MRS definition imposes as such that only quantifiers may scope between x and y—this is a property of most *grammars* written using MRS, rather than a property of the framework.

In French, adverbs occurring in the VP with an integrated intonation scope from left to right. This is illustrated here in (10), where the two adverbs can occur in two different orders but with a different reading. This scope-order correlation also explains why (11b) is ungrammatical: in this example, the syntactic configuration forces *vigoureusement* to scope over *probablement*, but this does not make sense semantically.

(10) a. Paul a souvent déjà répondu.
'It is often the case that Paul already answered.'
b. Paul a déjà souvent répondu.
'It is already the case that Paul answered often.'

(11) a. Paul protestera probablement vigoureusement.
'Paul will probably protest strongly.'
b. *Paul protestera vigoureusement probablement.

We analyze adverbs in the VP as complements, and use (12) to constrain their relative scope. Following Bouma et al. (2001), we assume that sisters of the verb correspond to noninitial members of the verb's DEPS ('dependents') list (the initial member is the subject). The DEPS list is formed from the verb's syntactic arguments plus an unbounded number of modifiers. (12) states how the scope of these modifiers is constrained: the first modifier's LTOP is identified with the LTOP of the verb, and thus will be the LTOP of the VP according to (9b). The first modifier then takes scope over the LTOP of the second modifier (remember from (9a) that an adverb's semantic argument must outscope the LTOP of its MOD value), etc. Finally the last modifier takes scope over the LBL of the relation associated with the verb. This constraints allows adverbs in the VP to make the exact same contribution to the semantics they would have made if they had been left-adjoined in the same order. Figure 4 illustrates the workings of (12) in a case with two adverbs in the VP, and figure 5 shows a graphical depiction of the MRS and its only resolution.

(12) *verb*→

$$\begin{bmatrix} \text{HEAD} & \boxed{1} \\ \text{ARG-ST} & \boxed{2} \\ \text{DEPS} & \boxed{2} \bigcirc \left\langle \begin{bmatrix} \text{LTOP} & \boxed{3} \\ \text{MOD} & \begin{bmatrix} \text{HEAD} & \boxed{1} \\ \text{LTOP} & h_1 \end{bmatrix} \end{bmatrix}, \begin{bmatrix} \text{LTOP} & h_1 \\ \text{MOD} & \begin{bmatrix} \text{HEAD} & \boxed{1} \\ \text{LTOP} & h_2 \end{bmatrix} \end{bmatrix}, \ldots, \begin{bmatrix} \text{LTOP} & h_{n-1} \\ \text{MOD} & \begin{bmatrix} \text{HEAD} & \boxed{1} \\ \text{LTOP} & \boxed{4} \end{bmatrix} \end{bmatrix} \right\rangle \\ \text{CONT} & \begin{bmatrix} \text{LTOP} & \boxed{3} \\ \text{RELS} & \left\langle \begin{bmatrix} \text{LBL} & \boxed{4} \end{bmatrix} \right\rangle \\ \text{HCONS} & \langle\,\rangle \end{bmatrix} \end{bmatrix}$$

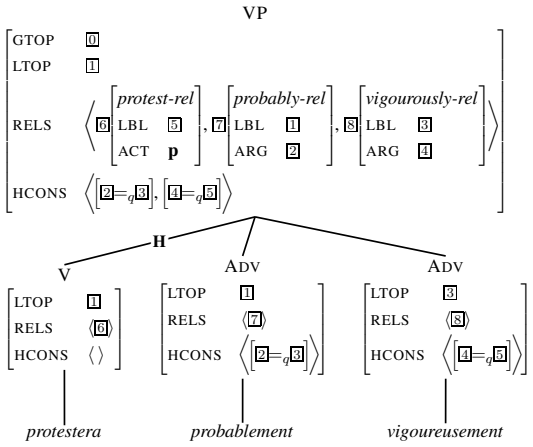


Figure 4: Partial HPSG representation for the VP in (11)

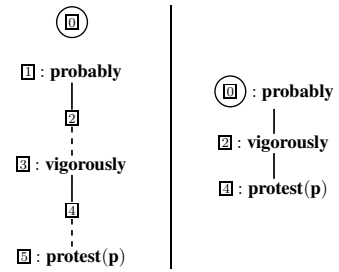


Figure 5: MRS and resolution for (11)

4 Evaluative adverbs in an underspecified semantic framework

Modelling evaluative adverbs in MRS is a challenge, because MRS encompasses a very strict notion of resource sensitivity. Fully specified semantic representations are trees, where each term contributed by a lexical item occurs on exactly one node

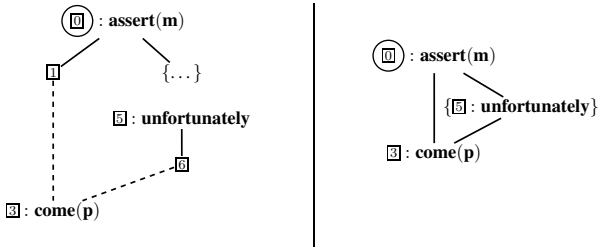


Figure 6: MRS and resolution for (13a)

in the tree. Thus if we were to model evaluative adverbs in standard MRS, the only solution would be to make a copy of the semantic material in the scope of the evaluative. This would be quite inconvenient, all the more so because it can't be known in advance (before the resolution stage) whether some material is in the scope of the evaluative or not.

Our solution is to simply remove the tree condition: we take semantic representations to be underspecified descriptions of rooted DAGs, instead of underspecified descriptions of trees. This allows us to model cases where the semantic contribution of a constituent is used twice in the semantic composition by having two arcs pointing to it. The interpretation function for resolved MRSs computes the denotation of a node from those of its daughters, without worrying whether these daughters also have another ancestor in the MRS.[8]

This modification of the MRS formalism allows directly for appropriate semantic representations for utterances containing evaluatives. Figure 6 shows the MRS we could associate with the simple sentence in (13a), and its only resolution. As proposed at the end of section 1, the illocutionary relation is explicitly represented, and has an extra, set-valued argument place. The value of this argument is not constrained by the grammar, but the intention is that the resolution process should allow parentheticals (and only parentheticals) to contribute members of the set. In figure 6, the evaluative *malheureusement* gets scoped within the set-valued third argument of **assert**. The resulting structure is interpreted just like the 'linearized' representation in (13b).

(13) a. Marie says: *Paul viendra malheureusement.*
Unfortunately, Paul will come.
b. **assert** $(\mathbf{m}, \mathbf{come}(\mathbf{p}), \{\mathbf{unfortunately}(\mathbf{come}(\mathbf{p}))\})$

Before we see how the grammar can be set up to provide MRSs such as the one in figure 6, we must make sure that moving from trees to DAGs does not have

[8]Note that it is crucial for the interpretation function to be definable that MRSs are acyclic.

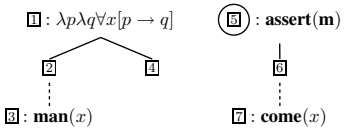


Figure 7: The MRS for (14)

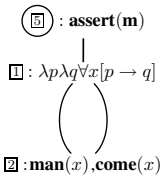


Figure 8: An unwanted resolution for the MRS in fig. 7

unwanted consequences. The main concern is that reentrancy should be limited to the specific case of arguments of parenthetical material. For instance, if we did not constrain reentrancy, The MRS figure 7 would have a reentrant resolution as shown in figure 8. Thus we would incorrectly predict the tautological (14b) as a possible reading for (14a).

(14) a. Marie says: *Chaque homme est venu.*
b. $\forall x[(\mathbf{man}(x) \wedge \mathbf{come}(x)) \rightarrow (\mathbf{man}(x) \wedge \mathbf{come}(x))]$

As it turns out, it is easy to avoid this type of situation. In HPSG grammars that use MRS for semantic representation (at least, in the grammar defined by Bonami and Godard (2003)), the grammar specifies some material for every predicate to scope over (although it does not preclude other material to scope in between). For instance the lexical entry of an adverb specifies that it must scope over the LTOP of the head it modifies. Verbs with clausal complements specify that they must scope over the LTOP of their complement; etc. As a result, such a grammar is affected by the move from trees to DAGs only insofar as multiple relations are allowed to take the same label. That is, if we disallow label coindexation but do not change the grammar, then moving from trees to rooted DAGs has no empirical consequence.

Copestake et al. (2003) use label coindexation as a way of modelling intersective modification: a sentence such as (15) receives the resolved MRS in figure 9. Copestake et al. argue in favor of such an analysis in the context of machine translation, where intersective modifiers in one language might turn out to be better translated as heads in another language.

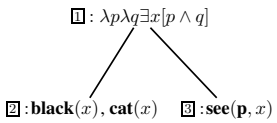


Figure 9: A resolved MRS for (15) under the assumptions of Copestake et al.

(15) Paul saw a black cat.

Since our concern here is purely linguistic rather than computational, we see no compelling reason to adopt this view of intersective modification. Moreover, since we explicitly use complex terms in our semantic representations, we can capture the intersective character of modifiers while keeping a uniform syntax-semantics interface for all modifiers: we take all modifiers to be scopal at the level of MRSs, and use semantic decomposition in the semantic terms to account for intersectivity.

We thus propose two modifications of the MRS formalism: (i) resolved MRSs are rooted DAGs, and (ii) no two relations are allowed to share a handle. With this restriction on handle identity, no special care is needed to avoid reentrant content within our current grammar. On the contrary, special interface principles must be used for reentrant representations to actually be produced by the grammar.

We now present our analysis of evaluatives. Parenthetical content is identified as such thanks to a boolean feature PARENTHETICAL on handles, which we appreviate [P ±] for brevity. Most words constrain the LBL of their relation to be [P −], but lexical parentheticals such as evaluatives are an exception, as shown in the lexical entry in (16).

(16) *malheureusement*:

$$\begin{bmatrix} \text{RELS} & \left\langle \begin{bmatrix} \textit{unfortunately-rel} \\ \text{LBL} & [\text{P}+] \\ \text{ARG} & [\text{P}-] \end{bmatrix} \right\rangle \end{bmatrix}$$

The illocutionary relation is introduced at the level of the *utterance* (Ginzburg et al., 2001), and takes three arguments, corresponding to the speaker, the main semantic content, and ancillary commitments of the speaker. The main semantic content must be nonparenthetical, but the ancillary commitments are parenthetical. Moreover nothing can outscope the illocutionary relation, since its label is identical to the global top.

(17) *utterance*→

$$\begin{bmatrix} \text{GTOP} & \boxed{1} \\ \text{RELS} & \left\langle \begin{bmatrix} \textit{illocutionary-rel} \\ \text{LBL} & \boxed{1} \\ \text{ARG1} & \boxed{3} \\ \text{ARG2} & \boxed{2}[\text{P}-] \\ \text{ARG3} & \textit{set}([\text{P}+]) \end{bmatrix} \right\rangle \oplus \boxed{R} \\ \text{HCONS} & \left\langle \left[\boxed{2} =_q \boxed{3}\right] \right\rangle \oplus \boxed{H} \\ \text{CONTEXT}|\text{C-INDICES}|\text{SPKR} & \boxed{i} \end{bmatrix}$$

$$\Big| \quad \begin{bmatrix} \text{RELS} & \boxed{R} \\ \text{LTOP} & \boxed{3} \\ \text{HCONS} & \boxed{H} \end{bmatrix}$$

To account for the evaluative itself, we must set it apart from ordinary semantic composition. We use a unary rule *paren-ph* to that effect. This rule turns a parenthetical modifier into a vacuous modifier: the head daughter's LTOP is ignored, and the modified sign's LTOP is passed up the tree.

(18) *paren-ph*→

$$\begin{bmatrix} \text{HCONS} & \boxed{L} \oplus \left\langle \left[\boxed{2} =_q \boxed{3}\right] \right\rangle \\ \text{LTOP} & \boxed{4} \\ \text{MOD} & \left[\text{LTOP} \quad \boxed{4}\right] \end{bmatrix}$$

$$\Big| \ \mathbf{H}$$

$$\begin{bmatrix} \text{LTOP} & \boxed{3}[\text{P}+] \\ \text{HCONS} & \boxed{L} \end{bmatrix}$$

Figure 10 illustrates all relevant features of our analysis of simple uses of evaluatives. Note that nothing in this tree says explicitly that *malheureusement* must be in the last argument of the illocutionary relation. However, since the adverb's content's LBL is marked as parenthetical, this is the only place it could scope to. Thus the only resolutions of the MRS associated with the sentence will be resolutions where 2 is identified with 5 and with a member of ARG3. Moreover, since every handle must label exactly one term, the value of ARG3 can only be the singleton {5}. As the reader can check, the result is precisely the MRS in 6.

The analysis also accounts for the interaction between evaluatives and other adverbs. Figures 11 and 12 show the MRSs and resolutions for the examples in (4). The general analysis of adverbial modification, together with the constraint

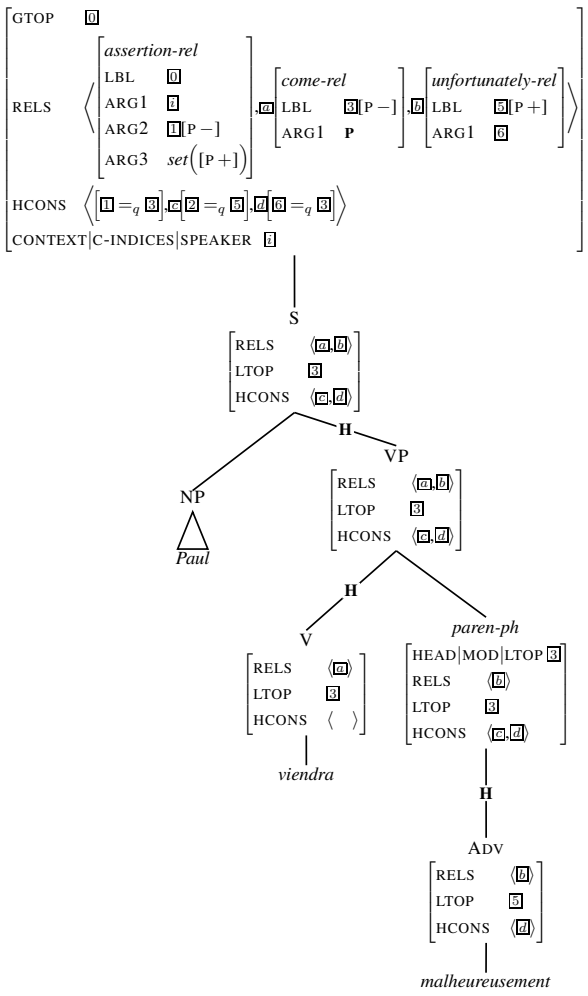


Figure 10: Partial HPSG representation for (13a)

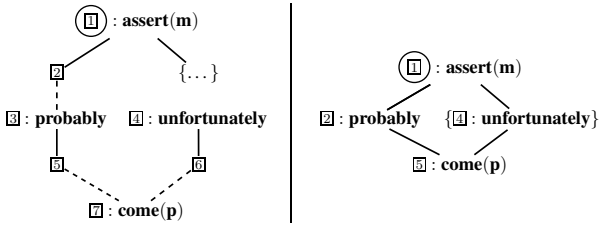


Figure 11: MRS and resolution for (4a)

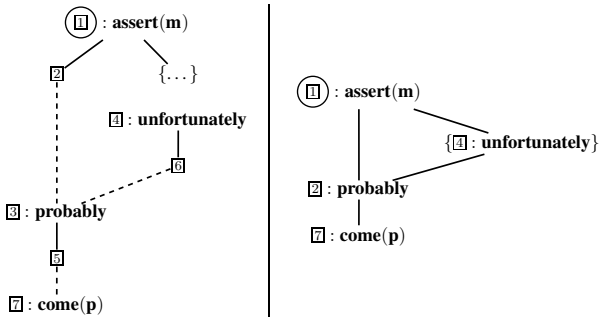


Figure 12: MRS and resolution for (4b)

on *paren-ph* in (18), entail that evaluative adjuncts take scope over adverbs they c-command, but do not fall in the scope of adjuncts c-commanding them.

Moreover, the analysis extends readily to more complex cases. First, it accounts for phrasal evaluatives such as the ones in (19). We assume that modifiers of adverbs and quantifiers do not have a lexical specification for the feature PARENTHETICAL, but inherit the specification of their argument (20). The effect of these constraints is that a quantifier or modifier is parenthetical whenever its semantic argument is. As a result, *très bizarrement* 'very oddly' is parenthetical, whereas *très gentiment* 'very kindly' is not. Thus only the first can be the daughter of a *paren-ph*.[9]

[9] Phrasal evaluatives are the reason why we need both the feature [P ±] and the unary rule *paren-ph*. [P ±] identifies content which will not feed the main semantic tree, but it cannot be simply assumed that a sign whose relation's label is [P +] is automatically 'set apart' from semantic com-

(19) a. Malheureusement pour chaque candidat, le poste a été supprimé.
'Unfortunately for every candidate, the position was cancelled.'

b. Très bizarrement, Paul n'a pas répondu.
'Very oddly, Paul did not answer.'

(20) a. *chaque*→
$$\left[\begin{array}{l}\text{RELS}\ \left\langle\left[\begin{array}{ll}\textit{every-rel}&\\ \text{LBL}&\left[\text{P}\ \boxed{1}\right]\\ \text{SCOPE}&\left[\text{P}\ \boxed{1}\right]\end{array}\right]\right\rangle\end{array}\right]$$

b. *très*→
$$\left[\begin{array}{l}\text{RELS}\ \left\langle\left[\begin{array}{ll}\textit{very-rel}&\\ \text{LBL}&\left[\text{P}\ \boxed{1}\right]\\ \text{ARG}&\left[\text{P}\ \boxed{1}\right]\end{array}\right]\right\rangle\end{array}\right]$$

Sentences with multiple evaluatives, such as (21), are not a problem: since the 'ancillary commitments' argument of illocutionary relations is set-valued, both *bizarrement* and *malheureusement* can scope there. Moreover, the ban on handles labelling multiple relations ensures that the two evaluatives indeed correspond to two independent commitments.[10]

(21) Malheureusement, Paul n'a pas répondu, bizarrement.
'Unfortunately, Paul did not answer, strangely.'

Finally, cases where the parenthetical is assumed by an agent other than the speaker are readily accommodated by assuming that speech report verbs also have an 'ancillary commitments' argument. Figure 13 depicts the MRS and the two possible resolutions for (22).

(22) Marie says: *Paul a dit que, malheureusement, Jean viendrait.*
'Paul said that, unfortunately, Jean would come.'

Note that there is no need for an explicit storage mechanism to keep track of parenthetical content. Remember that MRSs are defined as directed *acyclic* graphs. Thus we predict that (i) evaluatives embedded in a speech report, as in (22), may be commitments of either the speaker or the reported speech agent, but (ii) evaluatives occurring in the main clause, as in (23) can only correspond to commitments of the speaker. Figure 14 provides the MRS and the only resolution for (23). If we were to try and scope the evaluative under **say** instead of **assert**, we would end up with a

position and treated as an ancillary commitment: in *très bizarrement*, *bizarrement* enters an ordinary modification structure despite the fact that it is [P +]. Note that the [P ±] feature plays a role similar to Potts's distinction between *a*-types and *c*-types, while the unary rule *paren-ph* plays a role similar to his **comma** type-shifting operators.

[10] Note that one evaluative cannot outscope the other because evaluatives cannot take a [P +] argument.

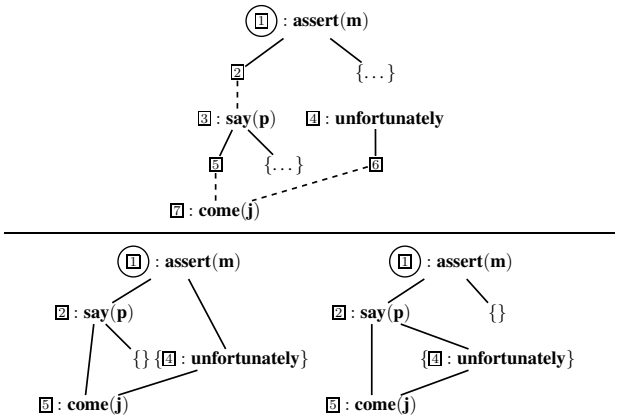


Figure 13: MRS and resolution for (22)

cyclic semantic representations, with *malheureusement* scoping over *dire* scoping over *malheureusement*.

(23) Marie says: *Paul a malheureusement dit que Jean viendrait.*
'Unfortunately, Paul said that Jean would come.'

References

Bach, Kent. 1999. The Myth of Conventional Implicature. *Linguistics and Philosophy* 22, 327–366.

Bonami, Olivier and Godard, Danièle. 2003. Incidental Adjuncts: An Overlooked Type of Adjunction, paper presented to the Tenth International Conference on HPSG, East Lansing, July 2003.

Bonami, Olivier and Godard, Danièle. 2005. Les adverbs évaluatifs dans une approche multidimensionnelle du sens. In Injoo Choi-Jonin, Myriam Bras, Anne Dagnac and Magali Rouquier (eds.), *Questions de classification en linguistique : méthodes et descriptions*, pages 19–37, Bern: Peter Lang, questions de classification en linguistique : méthodes et descriptions.

Bonami, Olivier, Godard, Danièle and Kampers-Manhe, Brigitte. 2004. Adverb

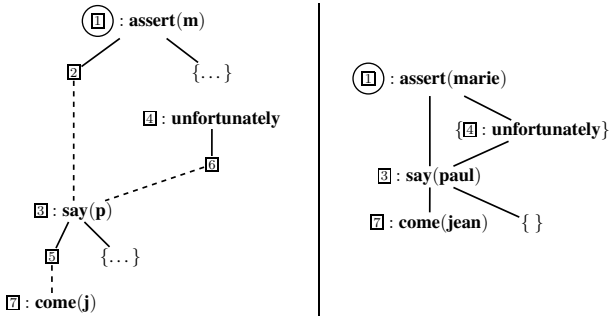


Figure 14: MRS and resolution for (23)

classification. In Francis Corblin and Henriëtte de Swart (eds.), *Handbook of French Semantics*, pages 143–184, CSLI Publications.

Bouma, Gosse, Malouf, Rob and Sag, Ivan A. 2001. Satisfying constraints on extraction and adjunction. *Natural Language and Linguistic Theory* 19, 1–65.

Copestake, Ann, Flickinger, Dan, Pollard, Carl and Sag, Ivan A. 2003. Minimal Recursion Semantics: an introduction, manuscript, University of Cambridge, Stanford University and Ohio-State University. Available at http://lingo.stanford.edu/sag/papers/copestake.pdf.

Dalrymple, Mary, Lamping, John and Saraswat, Vijay. 1993. LFG semantics via constraints. In *Proceedings of the Sixth Meeting of the EACL*, pages 97–105.

Geuder, Wilhelm. 2000. *Oriented Adverbs. Issues in the lexical semantics of event adverbs.*. Ph. D.thesis, Universität Tübingen.

Ginzburg, Jonathan. to appear. *A Semantics for Interaction in Dialogue*. Stanford and Chicago: CSLI Publications and the University of Chicago Press, draft chapters available at: http://www.dcs.kcl.ac.uk/staff/ginzburg/papers.html.

Ginzburg, Jonathan and Sag, Ivan A. 2000. *Interrogative Investigations*. Stanford: CSLI Publications.

Ginzburg, Jonathan, Sag, Ivan A. and Purver, Matthew. 2001. Integrating Conversational Move Types in the Grammar of Conversation. In P. Kühnlein, H. Rieser and Henk Zeevat (eds.), *Proceedings of BI-DIALOG 2001*.

Jayez, Jacques and Rossari, Corinne. 2004. Parentheticals as Conventional Implicatures. In Francis Corblin and Henriëtte de Swart (eds.), *Handbook of French Semantics*, pages 211–229, Stanford: CSLI Publications.

Klein, Ewan and Sag, Ivan A. 1985. Type-driven translation. *Linguistics and Philosophy* 8, 163–201.

Pollard, Carl and Sag, Ivan A. 1994. *Head-driven Phrase Structure Grammar*. Stanford: CSLI Publications; The University of Chicago Press.

Potts, Christopher. 2005. *The Logic of Conventional Implicatures*. Oxford: Oxford University Press.

Reape, Mike. 1994. Domain union and word-order variation in German. In John Nerbonne, Klaus Netter and Carl Pollard (eds.), *German in HPSG*, pages 151—197, Stanford: CSLI Publications.

Development of Semantic Pattern Dictionary for Non-linear Structures of Complex and Compound Sentences

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Abstract

Semantically Classified Sentence Pattern Dictionary has been compiled on the basis of *Semantic Typology* in order to develop an *Analogical Mapping Method* for MT. This dictionary includes 221,563 *Semantic Patterns* which have been generated from Japanese compound and complex sentences. The patterns have been made up in the semi-automatic manner using a set of variables (of full words) and functions (expressing aspect, tense, and modality). In the particular pattern, the literal remainders, however, exists including not only functional words but also *non-linear* portions which are untranslatable to the target language in the linear sequence of MT. The dictionary comprises *word-level*, *phrase-level* and *clause-level*. *Non-linear structures* of Japanese sentences having two or three predicates have been extracted from a parallel corpus including a million pairs for Japanese and English sentences. The suitable definition of the *linearity* and *non-linearity* of linguistic expressions has enabled the semi-automatic pattern generalization process and the efficient development of the pattern dictionary. Our experimental evaluations showed that this dictionary semantically covers 74% of compound sentences and 67% of complex sentences, and the development cost was reduced to one-tenth that of a human intensive development.

1 Introduction

Three years ago, we started the 5-year project to develop *Semantically Classified Sentence Pattern Dictionary (SP-dictionary)*, in order to realize a new MT method named *Analogical Mapping Method (AM-method)*. This project is conducted under the funding of the Japan Science and Technology Agency and have developed the first version of the *SP-dictionary*. This paper will give the outlines of *AM-method* and the report of the process and results in the *SP-dictionary* development.

A huge investment has been made in the research and development of MT technology, resulting in some noteworthy achievements (Nagao, 1996). However, it is more difficult to develop MT systems between languages belonging to different families alienated from each other, such as Japanese and English, and this development of the particular system requires even further effort to improve the quality and accuracy of the output.

One method for solving this problem is *Pattern-based MT* (Takeda, 1996a,b; Watanabe and Takeda, 1998). This problem-solvimg has already been used in many commercial systems combining the *Transfer-method* and *Translation-memory* (Nagao et al., 1998) since they are adequate technique of acceptable translations for matched sentences. However, the number of prepared patterns is too small to cover general expressions so that they are only used in the translations for special fields or for translation help. One of the reasons for this limitation is the high cost of developing large-scale pattern dictionaries, although the major reason is the difficulty of defining semantically consistent sentence patterns. Though there is a lot of research on SP-learning technology (Allmuallim et al., 1994; Güvenir

and Cicekli, 1998; Kitamura and Matsumoto, 1996), it is a long way from being actually used.

To address such problem, a *Multi-Level-Translating Method* (MLTM) (Ikehara et al., 1987) has provided an approach for grasping the relationship between structures and meanings in linguistic expressions, which will give a solution for breaking through the limitations of the traditional approach based on the *compositional semantics*. The implementation of the MLTM requires building up an extremely large language knowledge base by which patternized expressions can be accurately defined corresponding to the speaker's cognition of the objective world and his/her subjectivity. In the first step in the constructions process, such a knowledge base as *Goi-Taikei (A-Japanese-Lexicon)*, has already been compiled (Ikehara et al., 1997) resulting in a marked improvement in the translation quality of simple sentences (Kanadechi et al., 2001).

However, the MLTM has two problems (Ikehara, 2001a,b), one of which is that the method does not always produce optimal results of translations since it gives only one output corresponding to the syntactic structure of the target language. Another one is in how it handles the semantic *non-linearity* of complex sentences with multiple coordinate clauses and compound sentences of comprising one or more subordinate clauses.

To solve the above problems, an *AM-method* (Ikehara, 2002) has recently been proposed in which fundamentals thereof can be established by the *Semantic Typology* (Arita, 1987) and *Analogically Equivalent Thinking* (Ichikawa, 1960) theories. In this method, the *non-linear* sentence structures of a source language are semantically mapped into those of a target language using a *SP-dictionary* where one or more *semantic patterns* (SPs) for the target are defined corresponding to a pattern of the source.

2 Principles of *AM-method*

The AM-method[1] provides a problem-solving approach to the aporia in the semantic analysis and semantic understanding based on *compositional semantics*. The method is constructed from two theories: The first is the *Semantic Typology Theory* proposed by Arita (1987), which suggests that conceptual cognition is accompanied by an epistemological framework under the influence of one's mother tongue. The second is the *Analogical Mapping Theory* advocated by Ichikawa (1960). According to Ichikawa, a set of SPs in the source language can be mapped to a corresponding set in the target, with the use of an analogy between them by choosing an adequate common view-point.

With the combination of these two theories, we have brought forth a heuristic

[1]Nagao proposed an *Analogical Translation Method* based on the similarities between syntactic structures and word meanings used in corpus writings (Nagao, 1984; Sato, 1997). This is considered as basis for *Pattern-based MT*. By contrast, our method notices the similarities between the concepts represented by expression structures and goes beyond the similarity in syntactic structures.

approach to semantic analysis of the semantically in-decomposable expressions, the whole meaning of which is not just the simple sums of those of their component words. Such expressions, which are referred to as *non-linearity*, are then classified as SPs under *Logical Semantic Categories* (LSC). Given a Japanese sentence, its SP is determined using pattern matching, and then mapped to the corresponding English pattern, according to which a complete sentence will be generated.

(1) Theory of *Analogical Mapping*

Ichikawa (1960) formulated the analogical reasoning in scientific discovery and then proposed his *Analogical Mapping Theory* in "*Creative Thinking*", referred to as *Theory of Equivalent Transformation*, in 1960, stating that analogical thinking lies at the core of human creativity. This theory presented a sort of model of the creative process for problem-solving, provided that different systems have a commonality, ϵ, in their events or phenomena under a certain condition C, as shown in the following equation:

$$C(A_\alpha \stackrel{\epsilon}{=} B_\beta) \tag{1}$$

where C is a condition, ϵ is a commonality, A_α is an event in system α, and B_β is an event in system β.

Analogical thinking refers to the process according to above equation where given an event A_α(source) in system α, a human being develops in their mind an event B_β(target) in system β which has a commonality ϵ under a condition C.

(2) *AM-method* in MT

Technical difficulties arise when the numberless individual linguistic expressions of a language are mapped onto those of another language with their meanings correctly translated. However, these numberless expressions can be reduced to a finite number of semantic units by applying above equation.

In translating expression A_α in language α into an expression B_β in language β, language β must have expression B_β which implies a concept represented by the expression A_α. This logic provides the grounds for implementing the translations between different languages based on their meanings when the commonality ϵ is considered as a concept existing in both the source and target languages.

This technique is called the *AM-method* that uses *semantic types*. The following equation (2) shows the principles of the method:

$$A_\alpha \Rightarrow C(A_\alpha) \Rightarrow \epsilon \Rightarrow C(B_\beta) \Rightarrow B_\beta \tag{2}$$

Where ϵ is a *true item* (a collection of common concepts, i.e. a member of a LSC), and C is a function to typify a linguistic expression as an appropriate basic *semantic type*.

The equation (2) is applied to a translation when $\alpha \neq \beta$, and for rewording in the same language if $\alpha = \beta$.

(3) LSC (*Logical Semantic Category*)

The *semantic types* of the two languages are mapped via the LSC. This category is a set of concepts, each of which is usually represented by a *semantic type* (a unit of an expression categorized by its meaning). The category contains a set of *true items*. *True items* constitute two types: *true items* for simple concepts (represented by single word) and those for composite concepts (represented by multiword expressions). The categories and items are based on the *Semantic Attributes* of the *Valency Patterns* defined in "*A-Japanese-Lexicon*" (Ikehara et al., 1997).

(4) Mapping of *Semantic Types*

The *semantic types* formulated in the form of patterns, named as SPs, are classified in accordance with the *true items* stored in the LSC. Thus, the SPs of the source language can be semantically corresponded to those of the target language via the same *true items*. However, some SPs relating to complex concepts will be classified into several groups. Figure 1 and 2 show an application example of *AM-method* for Japanese to English MT system.

In the translation process, the most appropriate SPs of the target language are selected from the one or more instances that semantically correspond to the SP of the source language. The most appropriate, i.e. most similar in meaning, SP is dynamically selected during translation. To achieve this goal, the *SP-dictionary* provides contextual conditions concerning intra-sentences, inter-sentences, and contexts. Next, the retrieved Japanese SP is mapped to the corresponding English SP by means of an analogical mapping mechanism provided by the LSC. Finally, the English SP is processed to generate the translated equivalent. In this process, the Japanese components stored in the *linear component list* are translated by conventional methods and allocated to the appropriate variables of the English SP.

3 SP Generation for *Non-linear Expression*

An SP is considered as an epistemological framework for conceptual cognition and is individual to each language. In many cases, the structure of this framework does not satisfy the conditions of the *semantic composition*. SPs are defined from the view point of the *linearity* and *non-linearity* of expressions as will be described in the following sections.

3.1 Method of Judging *Non-linearity*

(1) Definitions of *linearity* and *non-linearity*

The development of conventional natural language processing technologies has been supported by the principle of *semantic composition*. There have been many studies and discussions among the adherents of *compositionality* and *contextuality* (Allen, 1995; Larson and Segal, 1995; Carpenter, 1998; Platts, 1997; Green et al., 2002; Cruse, 2004; Partee, 2004; Szabó, 2005). The compositional principle is known as Frege's definition of "*The meaning of a complex expression is determined*

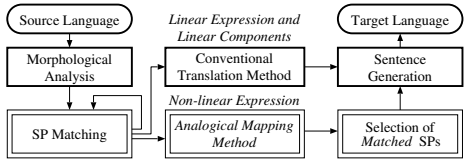

Figure 1: Translation process by *AM-method*

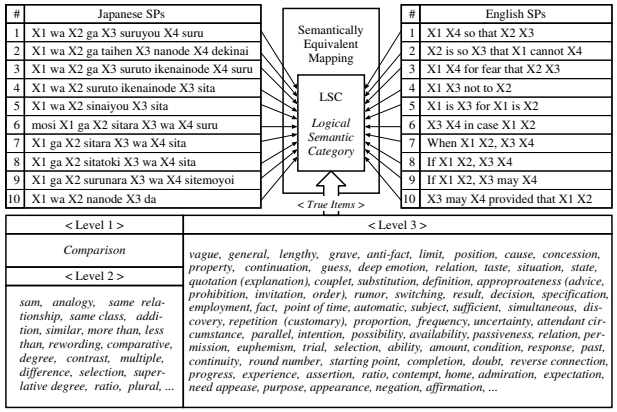

Figure 2: *Semantically Equivalent Mapping* of *SPs* via *True Items*

by the meanings of its parts, and the way in which those parts are combined".

The most typical example based on the principle will be *Transfer-method* for conventional MT system. In this method, the partial meanings of the whole of an original structure are directly expressed in the converted lexical structure in the target language and then combined together with each other to generate the target language expression, assuming that the meanings of parts are given by lexicon and the combination way is given by syntax.

However, this method has reached the limits. The original meanings in a sentence in the source language are lost during the translation process and high quality translation cannot be obtained, especially in the translation between the languages of different families.

We propose pattern based method for determining the meaning of the whole expression in advance, assuming that the meaning of the whole expression cannot be determined by the parts and but the meanings of the parts can be determined by the meaning of whole expression.

Linguistic expression is a means of representing speaker's conceptual cognition. A speaker first selects the most suitable expression structure from options occurred in his/her mind to represent his/her cognition and then specifies partial expressions for each component to complete the sentence while keeping the total meaning in his/her mind.

In this process, there are two types of components: One is the components which can be replaced by alternatives in a domain without changing the entire meaning. Another is the component which cannot be replaced by any other components. Then, we discriminate the former as a *linear components* and the latter as a *non-linear components*. The *linearity* and *non-linearity* of a component and an entire expression are defined in detail as follows:

Definition 1 : *Linearity* of components
A *linear component* of an expression is a component which can be replaced by an equivalent component with no change in the meaning of the expression itself.

Definition 2 : *Linearity* of an expression
An expression composed of only *linear components* is defined as a *linear expression*. Meanwhile, an expression comprising one or more *non-linear components* is defined as a *non-linear expression*.

Definition 3 : SP (*semantic pattern*)
SP is defined as an expression in a *non-linear expression*.

From the Definition 2 and 3, it can be understood that the principle of *semantic composition* holds for *linear expressions*. Our definitions is compatible to the Frege's explanation. According to the Frege's theory, the feature of *compositionality* of logical expressions is that if any part of an equation is replaced by another equivalent component, the total value, which is the meaning of the entire expression, does not change (Allwood et al., 1977). *Linear components* correspond to *compositional components* since they are replaceable with another equivalent components without changing the meaning, but the determination of whether *decomposable components* or not cannot be made without checking it's inner structure. In contrast to this, *non-linear components* cannot replaced with other components without changing the entire meaning so that they cannot said as *compositional component*.

It is very important to notice that there is no need to develop SPs for *linear expressions*, since such expressions can be processed by the conventional method based on *semantic composition*.

(2) Definition of Meaning for Linguistic Expressions

The meaning of SP needs clarification for the application of the above definitions to actual sentences. Considering the practical way of defining the meaning for an actual expression, a description has no more significance to a computer more

than a symbol, so that any description will do in so far as it is systematically defined. Hence, we describe the meaning of expressions for a source language by the expressions for a target language. This is easy and convenient way in designing a MT system.

From this definition it is assured that the *linear components* of the source expression have a semantically corresponding component in the target expression and the corresponding relationship of the entire expression does not vary with the replacement of these kinds of components. This matter establishes the principle for judging whether *linearity* or *non-linearity* with regard to an expression component. When the corresponding structure of the target expression does not change when a component of the source expression (i.e. word, phrase or clause) is replaced by alternatives, the component is judged as *linear*. Otherwise it is judged as *non-linear*.

(3) Characteristics of *linear components*

Figure 3 shows the example of *linear components*. Important aspects of the *linear component* defined above are as follows. First, although the replaceable component is defined as *linear*, it does not mean it is an unbounded replacement. It has a syntactically and semantically limited domain as shown in Figure 3.

Second, when all components are *linear*, the entire expression is defined as *linear*. However, the determination of whether *linearity* or not is dependent on the suitable selection of a component, and thus the *linearity* of the entire expression is dependent on the way in which the expression is divided into components.

Third, the *linear component* is defined in relation to the entire expression. This does not mean the *linearity* of itself. The internal structure of the *linear component* can be *non-linear* as shown in Figure 4.

Thus, the *linear components* can be separated again into *linear* and *non-linear components*, when the total expression has been separated into *linear components* and/or *non-linear*.

Above mentioned linguistic model is consistent with the "*Construction Grammar*" proposed by Fillmore (Fillmore et al., 2005). The importance of the information presented by patterns was also pointed out for the analysis of Multiword-Expressions (Baldwin and Bond, 2002; Sag et al., 2002).

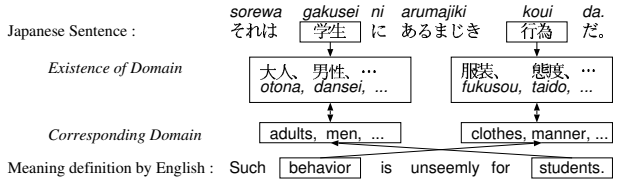

Figure 3: Example of linear components

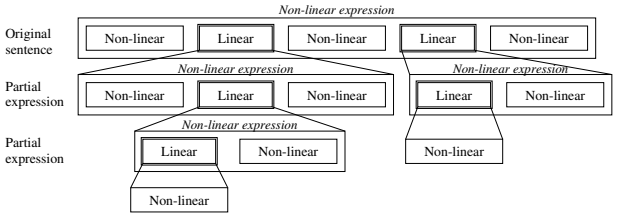

Figure 4: Recursive structure of *non-linear expressions*

3.2 Framework for defining SP

(1) SPs representing *non-linearity*

The SPs can be extracted by elimination of the *linear components* from the expressions while holding the intrinsic meaning of them. As a result of this abstraction, the *non-linear components* are retained but the *linear components* are replaced with arbitrary factors. These SPs are language-dependent. Japanese and English, for example, have their respective SPs.

The number of SPs would be finite in practice, although there are infinite variations of expressions in text and conversational speech, because a language does not have so many linguistic norms supporting the generation of SPs[2]. Therefore, it is feasible that a finite number of SPs are defined, to which the specific expressions in both languages are linked to implement the MT.

(2) *SP-Description Language*

In the development of an *SP-dictionary*, it is very important to obtain high coverage for actual expressions and semantic exclusiveness among the SPs. *SP-Description Language* (SP-DL) was developed to semi-automatically generate an *SP-dictionary* from a large-scale parallel corpus and to conduct matching *SP-dictionary* with input sentences using only morphological analysis results. Table 1 shows the constituents of SPs. The framework for the SP-DL will be described as follows:

SPs are defined using *essential* and *optional components*. The *essential* consist of *linear* and *non-linear components*: the *linear* are converted to abstract structure of *variables* and *functions*, whereas the *non-linear* are described by the same as literals in the original sentence. *Optional components*, on the other hand, are described by *symbols*. They are separated into "*hidden components*" and "*specified components*". In SPs, only the positions are defined for the former, but concrete

[2]SPs represent non-linear expressions that must be memorized to use them. Then, if the number of them is infinite, humans cannot use them freely because of their limited memory capacity. Our linguistic model will yield the answer to Plato's problem. The answer is that almost infinite linguistic expressions are generated from the recursive structure by combining the finite non-linear components as shown in the last section of this paper

Table 1: Elements for defining SPs

Classification		Explanations	
Literals	Japanese Character	Kanji, Hiragana, Katakana, Numerals, Alphabet	
	English Character	Alphabet, Numerals	
Variables (15 types)	Word Variable (9 types)	Represents *linear* full words: nouns, verbs, etc.	
	Phrase Variable (5 types)	Represents *linear* phrases: noun / verb phrases, etc.	
	Clause Variable (1 type)	Represents *linear* clauses	
Functions (107+α types)	Variable Function (8 types)	Change the syntactic attribute of variables	
	Literal Function (arbitrary types)	Check whether the literals of function name are included in the argument expression	
	Extract Function (2 types)	Subject and object extraction from phrases or clauses substituted in variables	
	Form Function (67 types)	Word Form(18 types)	Conjugation, etc.
		Others (49 types)	Tense, aspect and modality
	Sentence Generator (27 types)	Compose English sentence structure from one or more phrases or clauses	
	Macro Function (3 types)	Substitute a sentence structure with variables to an upper type variable	
Symbols (7 types)	Separator	Represents the positions for optional components	
	Continuation Mark	Represents the positions forbidding optional components	
	Component Selector	Represents a selectable component group	
	Optional Mark	Represents optional components	
	Permutation Mark	Represents permutable components	
	Changeable Position Mark	Represents removable components and positions	
	Supplementation Mark	Supplementation of erased subjects and objects	

expressions are defined for the latter.

In order to describe SPs generalized by *word-level*, *phrase-level* and *clause-level*, three kinds of variables, *word-variables* (9 types), *phrase-variables* (5 types) and *clause-variables* (1 type) are defined. Domains for these variables are semantically defined using *semantic attributes*. In the matching process with an input sentence, the matched component of the sentence is substituted to the corresponding variable. To represent synonymous words or expressions, symbols grouping the expressions with the same meaning and many different functions were prepared. The former is used not only for identifying different forms of a word but also for phrases equivalent to particles. The latter is used mainly to represent tense, aspect and modality.

The sequence of components in the matched SPs needs to be the same as those of the input sentence, in principle. However, word order for Japanese sentences is not firm. In many ways it can be permuted without changing the meaning. Therefore, a *description of arbitrary word orders* and a *description of changeable position words* were introduced.

4 SP Generations

4.1 Generation Method

(1) Examples of sentence pairs

The *SP-dictionary* has been developed for processing Japanese compound and complex sentences having two or three predicates. The reason for targeting such kinds of sentences will be described as follows:

The translation using the pattern dictionary has been achieved to the high degree (accuracy: 90%, limit of method: 98%) (Ikehara, 2001a) for simple sentences by the realization of "Goi-Taikei: *A-Japanese-Lexicon*" (Ikehara et al., 1997). But there is no semantic knowledge base for the *non-linear structures* of complex and compound sentences and translation quality still remains low.

The reason for restricting the number of predicates is as follows: In the case of sentences with 4 or more clauses, all clauses are merely *non-linear*. Many times, these sentences can be translated by separating them into plural sentences with 2 or 3 clauses.

A parallel corpus of a million sentence pairs was collected from 30 kinds of documents such as word dictionaries, handbooks for letter writing, Japanese text books for foreigners, and test sentence sets prepared for MT. A set of 128,713 applicable sentence pairs were semi-automatically extracted from them and used as example sentence pairs. Table 2 shows the types of component of speech and their number of appearance in the example sentences. The average number of words in Japanese sentences is 12.2 words.

(2) SP Generation

The example sentences are segmented by the morphological analyzer of ALT-JAWS (NTT, 2002) and the segmentation words and partial expressions of a Japanese sentence are semantically and semi-automatically brought into correspondence with those of an English sentence by using Japanese to English dictionaries. In this

Table 2: Word Appearances in Example Sentences

#	Part of Speech	Total Frequency	Different Words	Frequency / Word
1	Noun	417,886	56,861	7.4
2	Real Verb	223,178	10,324	21.6
3	Pseudo Verb	51,918	271	191.6
4	Adjective	31,681	915	34.6
5	Adjective Verb	19,587	2,562	7.6
6	Adverb	39,051	3,191	12.2
7	Adnominal	32,585	731	44.6
8	Conjunction	3,146	77	40.9
9	Interjection	147	60	2.5
10	Prefix	1068	110	9.7
11	Suffix	1749	336	5.2
12	Auxiliary Verb	165,251	236	700.2
13	Particle	465,811	349	1334.7
14	Symbol	121,555	32	3798.6
–	Total	1,574,613	76,055	20.7 / word

process, synonymous words and/or expressions are checked out by the ALT-JAWS and automatically rewritten into canonical forms. For the semantic constraints for *variables*, 2,718 types of *semantic attributes* registered in *Goi-Taikei* (Ikehara et al., 1997) and *Ruigo Daijiten* (Shibata and Yamada, 2002) are used. A newly designed semantic attribute system is used for declinable words (verbs, adjectives, etc.).

The SPs were generated in the order of *word-level* SPs, *phrase-level* SPs and *clause-level* SPs as shown in Table 3. Examples of SPs are shown in Figure 5.

It was necessary to have 13.6 person-years of analysts for the development of the *SP-dictionary*. According to the partial experiments of writing patterns by human, the cost of developing this dictionary was estimated to have reduced to one-tenth compared to the cost necessary for a solely manpower based development.

Table 3: Generalization Levels of SPs

Level	Processes of Generalization
word-level	(1) Marking of optional, **(2) Replacement of *linear words* by variables,** (3) Replacement of predicate ending by functions, (4) Designation of equivalent component groups.
phrase-level	**(1) Replacement of *linear phrases* by variables and word variables by phrase variables,** (2) Normalization of polite expressions, (3) Expansion of functional words.
clause-level	**(1) Replacement of *linear clauses* by variables,** (2) Application of the functions which transform Japanese clauses to English phrases, (3) Application of the functions creating English sentence structures.

	word-level SP
Japanese SP	#1 [$N1$(G4) は/*ha*]/$V2$(R3003) て/*te*/$N3$(G932) を/*wo*/$N4$(G447) に/*ni*/$V5$(R1809).*tekita*。
Example	うっかりして 定期券を 家に 忘れてきた。 ukkarisite teikikenwo ieni wasuretekita
English SP	I was so $AJ(V2)$ as to $V5$ #1[$N1$.*poss*] $N3$ at $N4$.
Example	I was so careless as to leave my season ticket at home.
	phrase-level SP
Japanese SP	$NP1$(G1022) は/*ha* / $V2$(R1513).ta / $N3$(G2449) に/*ni* / $V4$(R9100).*teiru* のだから/*nodakara* / $N5$(N1453).*dantei*。
Example	その結論は 誤った前提に 基づいて いるのだから 誤りである。 sonoketsuronwa ayamattazenteini motoduite irunodakara ayamaridearu
English SP	$NP1$ is $AJ(N5)$ in that it $V4$ on $AJ(V2)$ $N3$.
Example	The conclusion is wrong in that it is based on a false premise.
	clause-level SP
Japanese SP	$CL1$(G2492).*teiru* ので/*node*、$N2$(G2005) に当たっては/*niatatteha*/$VP3$(R3901).*gimu*
Example	それは 極めて 有毒であるので、 使用に当っては sorewa kiwamete yuudokude arunode siyouniatattewa 十二分に 注意しなくてはならない。 juunibunni chuuisinakutehanaranai
English SP	*so+that*($CL1$,$VP3$.*must.passive* with subj($CL1$)_*poss* $N2$)
Example	It is significantly toxic so that great caution must be taken with its use
c.f. G#:Semantic Attribute Number defined by *A-Japanese-Lexicon* (Ikehara et al., 1997). R#:Semantic Attribute Number defined by *Ruigo Daijiten* (Shibata and Yamada, 2002).	

Figure 5: Examples of Generated SPs

5 Statistics of SP-dictionary

5.1 Quantity of Generated SPs

The number of different SPs are shown in Table 4. The original number of SPs was 245,721 in total but they include 24,158 of the same SPs. The ratios of the same SPs were 5%, 16% and 12% for each level. Then, the number of different SPs was reduced to 221,563. The ratios of the numbers of *word-level*, *phrase-level* and *clause-level* SPs to the example sentences are 99.5%, 81.3% and 10.1%.

The number of *clause-level* SPs is much smaller than that of the example sentences. This smaller number means that most of the clauses in the example sentences have *non-linearity* which makes much difficult to convert the expression to the target language. Hence the MT methods based upon *compositional semantics* cannot deliver the expected results of high quality translations as shown in the example.

Table 4: The Number of Different SPs

Sentence Type	No. of Predi-cates	Explanation	No. of Example Sentence	Generated Sentence Patterns			
				word level	*phrase level*	*clause level*	Total
Type 1	2	1 conjugation	57,235	53,578	37,356	5,521	96,455
Type 2	3	2 conjugation	6,196	6,080	4,952	417	11,449
Type 3	2	1 embedding	46,907	44,008	30,932	3,185	78,125
Type 4	3	2 embedding	5,986	5,889	5,084	811	11,784
Type 5	3	1 conj. + 1 emb.	12,389	12,174	10,025	1,551	23,750
—	–	Total	128,713	121,729	88,349	11,485	221,563

5.2 The Ratio of *Linear* and *Non-linear Components*

(1) Frequency of Variables

Table 5 shows the types and the frequency of the variables used in SPs.

The analysis of the frequency of variables will be described as follows: The total number of full words in the example sentences was 763,968. Out of those, there were 472,521 *word variables*. The ratio of the full words replaced by variables was 62%. Out of 5.9 words per sentence, 3.7 full words were replaced by *word variables* as *linear components*, and thus 2.2 full words kept literals as *non-linear components*. Meanwhile the number of phrases replaced by *phrase variables* was 102,000. In contrast to the word and phrase variable replacements, the number of clauses replaced by variables was only 11,580 (4.3%) out of 267,601 clauses.

Compared to full words and phrases, the *linearity* of clauses was extremely low. This fact shows that a Japanese complex or compound sentence are often translated into simple English sentences. Therefore, high-quality translations, as shown in the example, cannot be expected using conventional MT methods based on *compositional semantics*.

Table 5: Frequency of Variable used in SPs

Type of Variables	Type of SP			
	word-level		*phrase-level*	*clause-level*
Noun (N)	303,319		138,033	10,135
Time Noun ($TIME$)	8,527	(417,886)	5,187	529
Numeral (NUM)	6,036		2,314	189
Verb (V)	101,484	(223,178)	48,036	4,254
Adnominal (REN)	21,241	(32,585)	2,158	127
Adverb (ADV)	11,491	(39,051)	7,631	603
Adjective (AJ)	10,950	(31,681)	6,193	425
Adjective Verb (AJV)	9,473	(19,587)	6,273	434
Sub-total for Word Var.	472,521	(763,968)	215,825	16,696
Verb Phrase (VP)	—		58,908	2,838
Noun Phrase (NP)	—		40,629	1,985
Adjective Phrase (AJP)	—		1,341	78
Adjective Verb Phr. ($AJVP$)	—		935	37
Adverb Phrase ($ADVP$)	—		117	8
Sub-total for Phrase Var.	—		101,930	4,946
Clause (CL)	—		—	11,580 (267,601)
Total	472,521		317,755	21,942
No. of SPs	121,729		88,349	11,485
No. of variables / SP	3.88 / SP		3.60 / SP	1.91 / SP

c.f. (nn,nnn) = No. of appearance of words in the original sentence

Table 6: Average number of the functions used in SP

Type of Function	*word-level*	*phrase-level*	*clause-level*	Total
Tense	33,660	33,675	5,798	73,133
Aspect	13,642	15,598	3,183	32,423
Modality	38,952	38,923	6,514	84,389
Total	86,254	88,196	15,495	189,945
No. of SPs	121,729	88,349	11,485	221,563
No. of Functions / SP	0.709/SP	1.00/SP	1.35/SP	0.86/SP

(2) Frequency of Functions

The average number of the functions used in SP is shown in Table 6. The frequency of function use in the three levels were 86,295, 88,193 and 15,495 respectively. This corresponds to 0.7, 0.95 and 1.5 per SP. It can be observed that generalization has progressed with the level of SPs.

5.3 Discussion

Out of the example sentence pair, 302 sentences (0.23%) had not any *linear component* to be replaced by a variable or a function and most of the example sentences (more than 99%) had one or more *linear components*. The former sentence pairs were kept as literal patterns.

On the other hand, 15 SPs in *word-level*, 401 SPs in *phrase-level* and 155 SPs in *clause-level* had no literal element. Only these are SPs for *linear sentences* defined by 3.2 (2) (see “definition 2”). Then it can be seen that most of complex and compound Japanese sentences are non-linear expressions that are difficult to translate into English by the method of *Semantic Composition*.

But, it is very important to notice that most of these sentences have one or more *linear components* (on average 4-5 components). This implies the capability of developing the *SP-dictionary* with high coverage. Pattern translation method will be expected to overcome the limitation of *Example-based* MT.

6 Evaluation of Coverage and Precision

The most important parameters for evaluating *SP-dictionary* will be coverage for input sentences and semantic exclusiveness of the SPs retrieved from the dictionary. In this section, we will evaluate *Matched Pattern Ratio* and *Precision* for the matched SPs.

6.1 Evaluation Conditions

As one of the method to realize semantic exclusiveness, selectional restriction has been realized. The domains of *variables* are restricted by using semantic attribute system. But, there are many ways to select the correct SPs for input sentences when retrieved SP candidates for an input sentence contain one or more correct SPs. Our experiments showed that correct SPs can be find by the accuracy of more than 90% by using *Multivariate Analysis*. Then, the experiments were conducted neglecting semantic attributes given to variables and coverage were obtained.

The experiments were conducted in the manner of *Cross Validation*. 10,000 input sentences were randomly selected from the original example sentences, so that any input sentence is assured to match the pattern that had been obtained from itself. Therefore such pattern were excluded from matched patterns and coverage for the *SP-dictionary* was evaluated using a *Matched Pattern Ratio* and *Precision* as follows.

Matched Pattern Ratio **($P0$):** The ratio of input sentences that have one or more matched SPs

Precision **($P1$):** Semantically-correct ratio of the matched SPs (corresponding to a random selection method)

Accumulative Precision **($P2$):** The ratio of matched SPs containing one or more semantically-correct candidates (corresponding to the most suitable candidate selection method)

Matched Pattern Ratio means syntactic coverage. Matched SPs yield the results of syntax analysis but do not always yield semantically-correct translations. Semantically correct candidates, on the other hand, assure semantically-correct translations. Thus, $P0 \times P2$ represents semantic coverage of the *SP-dictionary*.

6.2 Evaluations of *Matched Pattern Ratio*

(1) Saturation of Coverage

The relationship between the *Matched Pattern Ratio* ($P0$) and the number of SPs were evaluated (Figure 6). $P0$ tends to saturate in the tens of thousands of SPs. Effective coverage cannot be obtained by less than ten thousand SPs. Several tens of thousands of SPs will be necessary for an actual use.

(2) Coverage of *SP-dictionary*

$P0$ for *word-level*, *phrase-level*, and *clause-level* SPs are shown in Table 7. In this table, "*entire match*" means the ratio that one or more entirely matched SPs were found for an input sentence. "*Partial match*" means the ratio that there were one or more patterns, the matching conditions of which were satisfied by the input sentence but there were additional components in it.

In the case of *word-level* SPs, *entire match* ratio is low compared with that of "*partial match*". Coverage of *phrase-level* SPs is the highest and most promising. Compared to this, that of *clause-level* SPs is not high. This is because of the low number of SPs.

(3) Number of Matched Patterns

Many times, one or more SP matched to an input sentence. Also, the way a SP matches the input sentence is not always limited to one. The number of matched SPs per input sentence is shown in Table 8.

From this table, it is found that many SPs matched to an input sentence and also there are some matching ways for a SP. These are remarkable for *phrase-level* SPs.

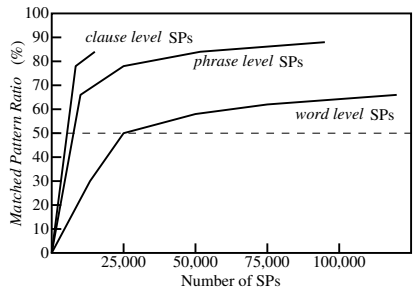

Figure 6: Saturation of *Matched Pattern Ratio* ($P0$)

Table 7: *Matched Pattern Ratio* of *SP-dictionary*

Level of SP	*entire match*	*partial match*	*Matched Pattern Ratio* ($P0$)
word-lv.	15.1 %	50.9 %	66.0 %
phrase-lv.	50.0 %	40.0 %	89.9 %
clause-lv.	44.2 %	40.3 %	84.5 %
Total	56.2 %	35.6 %	91.8 %

Table 8: Number of Matched Patterns per input Sentence

Level of SP	No. of Matched SPs	No. of Total Matchings	Matchings per SP
word-lv.	17.1	31.9	1.9
phrase-lv.	68.4	283.8	4.1
clause-lv.	12.1	57.9	4.8

(For the case of input sentences which have matched SPs)

6.3 Evaluations of Precision

(1) Evaluation Results

The results of $P1$ and $P2$ are also shown in Table 9. Compared to $P1$, $P2$ is a few times higher. This means that the matched SPs contain many incorrect candidates.

(2) Capability of Correct Translations

Although *word-level* SPs will assure high-quality translations, the coverage is small because of the high individuality. Meanwhile, the coverage of *phrase-level* SPs and *clause-level* SPs are high, but their translation quality will not be as accurate compared to *word-level* SPs. Then, *word-level*, *phrase-level* and *clause-level* order will be suitable to use for the matched SPs of an input sentence. The ratios for each level of SP used for the translation are shown in Figure 7.

This figure shows that 67-74% of input sentences can be translated directly using the *SP-dictionary*. As previously mentioned, SPs are defined for *non-linear sentence structures*, in principle. If we leave the translation of *linear sentence structures* to a conventional MT method, a 67-74% semantic coverage will be very effective. However, there are many possibilities of a further improvement in the semantic coverage. We are now going to try a further generalization for tense, aspect and modality to achieve a semantic coverage of 80-90%.

Table 9: Evaluation Results for Precision

Level of SP	*Precision* ($P1$)	*Accumurative Precision* ($P2$)
word-lv.	30.5%	69.0%
phrase-lv.	24.4%	66.2%
clause-lv.	13.8%	52.2%

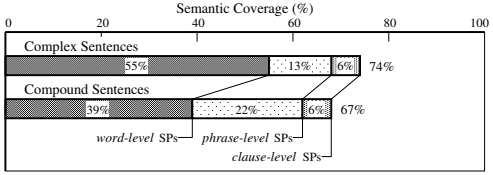

Figure 7: Semantic Coverage of *SP-dictionary*

7 Conclusion

In order to realize the *AM-method* for MT, the *SP-dictionary* for complex and compound sentences was developed and the quality was evaluated. This dictionary includes 221,563 SP pairs consisting of three kinds of SPs: *word-level* (121,729 pairs), *phrase-level* (88,349 pairs) and *clause-level* (11,485 pairs).

This dictionary was semi-automatically generated from 128,713 example sentence pairs, which were extracted from a one million sentences parallel corpus of Japanese-to-English translations.

The suitable definition of the *linearity* and *non-linearity* of linguistic expressions has enabled the semi-automatic pattern generalization process. Thus, the development cost was reduced to one-tenth that of a human intensive development. From the analysis of these SPs, it was clarified that the ratios for *linear components* were 62% for full words, 22% for phrases, and 4.3% for clauses.

These results shows the following concluding remarks: many *non-linear components* exsist in actual sentences and most of clauses are *non-linear*, which means that high-quality translations cannot be expected by using conventional MT methods based on *compositional semantics* and thus that it is very important to develop the method for dealing with *non-linear expressions*.

Matched Pattern Ratios of SPs were 66.0% for *word-level*, 89.9% for *phrase-level*, and 84.5% for *clause-level* SPs. It was also found that 74% of complex sentences and 67% of compound sentences are expected to be translated directly by the *SP-dictionary*. This dictionary leaves room for further generalization particularly for tense, aspect and modality.

We will report the evaluation results for the *AM-method* in the near future.

Acknowledgements

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References

Allen, J. 1995. *Natural Language Understanding*. The Benjamin/Cummings Publishing Company.

Allmuallim, I., Akiba, Y., Yamazaki, T., Yokoo, A. and Kaneda, S. 1994. Two Methods for Learning ALT-J/E Translation Rules from Examples and a Semantic Hierarchy. In *Proc. of COLING*, volume 1, pages 57–63.

Allwood, J., Andersson, L. and Dahl, O. 1977. *Logic in Linguistics*. Cambridge University Press.

Arita, J. 1987. *Lecture of Germany*, pages 48–56. Nan-undo Publisher.

Baldwin, T. and Bond, F. 2002. Multiword Expressions: Some Problems for Japanese NLP. In *Proc. of Annual Meeting of the Association for Natural Language Processing*, pages 379–382.

Carpenter, B. 1998. *Type-Logical Semantics*. MIT Press.

Cruse, A. 2004. *Meaning in Language: An Introduction to Semantics and Pragmatics*. Oxford University Press, second edition.

Fillmore, C., Kay, P., Michaelis, L. A. and Sag, I. A. 2005. *Construction Grammar*. Stanford Univ Center for the Study.

Green, R., Bean, A. A. and Myaeng, S. H. (eds.). 2002. *The Semantics of Relationships An Interdisciplinary Perspective*. Kluwer Academic Publishers.

Güvenir, H. A. and Cicekli, I. 1998. Leaning Translation Templates from Examples. *Information Systems* 23(6), 353–363.

Ichikawa, K. 1960. *Methodology for Creative Research*. Sanwa Shobo.

Ikehara, S. 2001a. Challenge to the Fundamental Problems on Natural Language Processing. *Japanese Society of Artificial Intelligence* 16(3), 422–430.

Ikehara, S. 2001b. Meaning Comprehension Using Semantic Patterns in a Large Scale Knowledge-Base. In *Proc. of PACLING*, pages 26–35.

Ikehara, S. 2002. Toward the Realization of Ultimate MT Method = MT Method based on Analogical Thinking =. *AAMT Journal* (32), 1–7.

Ikehara, S., Miyazaki, M., Shirai, S. and Hayashi, Y. 1987. Recognitions and Multilevel Machine Translation Method based on It. *Journal of IPSJ* 28(12), 1269–1279.

Ikehara, S., Miyazaki, M., Shirai, S., Yokoo, A., Nakaiwa, H., Ogura, K., Ooyama, Y. and Hayashi, Y. 1997. *Nihongo Goi-Taikei (A-Japanese-Lexicon)*. Iwanami Publisher.

Kanadechi, M., Ikehara, S. and Murakami, J. 2001. Evaluation of English Word Translations for Japanese Verbs using Valency Patterns. In *Proc. of Annual Meeting of IPSJ*, volume 2, pages 267–268.

Kitamura, M. and Matsumoto, Y. 1996. Automatic Extraction of Word Sequence Correspondence in Parallel Corpora. In *Proc. of Workshop on Very Large Corpora*, pages 79–87.

Larson, R. and Segal, G. 1995. *Knowledge of Meaning - An Introduction to Semantic Theory* -. MIT Press.

Nagao, M. 1984. *A Framework of a Mechanical Translation between Japanese and English by Analogy Principle*, pages 173–180. North-Holland.

Nagao, M. 1996. *Natural Language Processing*. Iwanami Publisher.

Nagao, M., Kurohashi, S., Sato, S. and Nakano, H. 1998. *Sience of Natural Language*, volume 9, Chapter Linguistic Information Processing. Iwanami Publisher, Tokyo.

NTT, Communication Science Lab. 2002. ALTJAWS: Japanese Automatic Word Separator. (http://www.kecl.ntt.co.jp/icl/mtg/resources/altjaws.html).

Partee, B. H. 2004. *Compositionality in Formal Semantics*. Blackwell Publishing.

Platts, M. B. 1997. *Ways of Meaning - An Introduction to a Philosophy of Language* -. MIT Press, second edition.

Sag, I. A., Baldwin, T., Bond, F., Copestake, A. and Flickinger, D. 2002. Multiword Expressions: A Pain in the Neck for NLP. In *Proc. of CICLing*, pages 1–15.

Sato, S. 1997. *Machine Translation based on Analogy*. Kyoritsu Publisher, (in Japanese).

Shibata, T. and Yamada, S. 2002. *Ruigo Daijiten (A large thesaurus)*. Koudansha Publisher.

Szabó, Z. G. 2005. Compositionality. In *The Stanford Encyclopedia of Philosophy*, (http://plato.stanford.edu/archives/spr2005/entries/ compositionality/).

Takeda, K. 1996a. Pattern-based Context Free Grammars for Machine Translation. In *Proc. of ACL*, pages 144–151.

Takeda, K. 1996b. Pattern-based Machine Translation. In *Proc. of COLING*, volume 2, pages 1155–1158.

Watanabe, H. and Takeda, K. 1998. A Pattern-based machine translation system extended by example based processing. In *Proc. of COLING*, pages 1369–1373.

A Linearization-Based Theory of Non-Constituent Focus

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Abstract

In this paper, we argue, mainly on the basis of Japanese data, that we need a theory of focus in which a contiguous sequence of expressions that does not form a morphosyntactic constituent is allowed to serve as a single focus, rather than merely as a sequence of two or more foci, and then present such a theory within the framework of linearization-based HPSG. In the proposed theory, prosodic constituents ("domain objects" in the HPSG parlance), rather than morphosyntactic constituents ("signs"), are claimed to be the principal carriers of semantic information, and meaning assembly is carried out on the basis of prosodic, rather than syntactic, structure. This theory, if correct, means that there is a certain dissociation between the morphosyntactic structure of a sentence and the way its parts are semantically put together.

The purpose of this paper is to present a linguistically adequate theory of non-constituent focus. We use the term *focus* in the same way as authors such as Rooth and Krifka; we say that a linguistic expression or a sequence thereof is a focus when it is interpreted as contrasting with some other entity (or entities) of the same type. A *non-constituent focus* is a contiguous sequence of expressions that does not form a morphosyntactic constituent and yet is interpreted as a single focus.

In section 1, we review two existing theories of non-constituent focus, and argue that neither of them is satisfactory. In section 2, we describe a version of HPSG in which semantic composition is carried out largely on the basis of prosodic, rather than syntactic, structure. And in section 3, we present our theory of non-constituent focus, exploiting the key features of the theoretical framework described in section 2. The paper will conclude with an observation regarding whether or not the theory proposed in this paper is consistent with the principle of compositionality.

1 Previous theories of (apparent) non-constituent focus

In this section, we will review two existing theories of non-constituent focus: a theory based on the notion of higher-order unification (Pulman (1997)) and a theory that relies on a sophisticated notion of givenness (Schwarzschild (1999)).

1.1 Pulman (1997)

In Pulman's theory of focus, it is assumed that we can somehow identify which elements of the sentence meaning are focused, either because of their syntactic configuration or via intonation, and that these elements are available as arguments to focus-sensitive functors such as *only* and *also*. A focus-sensitive functor like *only* takes two arguments: a list consisting of the meaning of each focus contained in its sister node and (roughly speaking) the meaning of that sister node itself. For example, a VP like *only introduced BILL to SUE* is interpreted as follows:

†We thank Mark Steedman and the three reviewers for the workshop for their insightful comments. Needless to say, they should not be held responsible for what we say in the present paper.

(1) $\lambda x.only\left([\![\text{Bill}]\!] \bullet [\![\text{Sue}]\!], introduced\,(x, bill, sue)\right)$

where $A \bullet B$ is a list consisting of A and B. The result of combining this VP and an NP *John* is interpreted as in (2):

(2) $only\left([\![\text{Bill}]\!] \bullet [\![\text{Sue}]\!], introduced\,(john, bill, sue)\right)$

In interpreting this semantic representation, we first 'subtract' the meaning of the two focused elements from the meaning of the S, using the mechanism of higher-order unification. The result of this 'subtraction' is a two-place predicate expressing a relation that holds between two NP meanings X and Y if and only if John introduced X to Y. Combining the meaning of the two focused elements and the meaning of this two-place predicate in an appropriate manner, we can state the correct truth condition of this sentence, roughly along the lines suggested in the Structured Meaning approach (Krifka (1991)): the sentence *John only introduced BILL to SUE* is true if and only if Bill and Sue are the only pair of individuals that satisfies the binary relation that holds between two NP meanings X and Y if and only if John introduced X to Y.

Pulman discusses the following example, in an attempt to demonstrate that his theory is capable of dealing with non-constituent focus.

(3) "What happened to Mary?" "JOHN KISSED her."

Pulman regards the string *JOHN KISSED* in the second sentence of this example as an instance of non-constituent focus. In his analysis of this sentence, he first computes the meaning of the entire sentence and the meaning of the two focused elements, *JOHN* and *KISSED*, and then he subtracts the meaning of the two focused elements from the meaning of the S in order to arrive at the correct truth condition for the sentence.

This analysis is unproblematic for this particular example, but it is not an adequate analysis of non-constituent focus in general. As should be clear even from the brief exposition above, Pulman's analysis of non-constituent focus is identical to his analysis of an example like *John only introduced BILL to SUE*, which involves two separate foci (which could have been associated with two different focus-sensitive functors). Consequently, his theory has difficulty in dealing with cases where a non-constituent is demonstrably functioning as a single focus, not as a sequence of separate foci. Consider the Japanese examples in (4) and (5), taken from Yatabe (1999). In these examples, prosodically prominent words are capitalized, as in many other examples used in this paper. We say that an expression in a Japanese sentence is *prosodically prominent* (or that it *receives prosodic prominence*) when (i) either the initial mora of the expression has audibly undergone Initial Lowering (i.e., it is pronounced audibly lower in pitch than the second mora)[1] or the initial mora of the expression is accented[2] and hence incapable of

[1]For information on Initial Lowering, see Pierrehumbert and Beckman (1988), Kubozono (1993), and the references cited there.

[2]Here, and throughout this article, when we say that a Japanese expression is *accented*, what we mean is not that the expression is pronounced higher or louder than usual but that the expression

undergoing Initial Lowering and (ii) none of the high tones associated with the expression is downstepped (i.e., pronounced lower in pitch than the preceding high tone)[3] or otherwise subdued.

(4) ([[Sutanfôdo no KONPYÛTA o] tsukatta] koto wa aru
[[Stanford GEN computer ACC] use-PAST] NML TOP exist-PRES
kedo, though)
[[Sutanfôdo no KYANPASU e] itta] koto wa
[[Stanford GEN campus LOC] go-PAST] NML TOP
NAI.
exist.NEG-PRES
'(I've used a computer of Stanford University before, but) I've never visited the campus of Stanford.'

(5) ([[Hanako no KAO ga] mieta] koto wa aru kedo,
[[Hanako GEN face NOM] be visible-PAST] NML TOP exist-PRES though)
[[Hanako no KOE ga] kikoeta] koto wa ICHIDO mo
[[Hanako GEN voice NOM] be audible-PAST] NML TOP once even
nai.
exist.NEG-PRES
'(There has been a situation in which Hanako's face was seen, but) there's never been a situation in which Hanako's voice was heard.'

In (4), the non-constituent *KYANPASU e itta* 'went to the campus' appears to be interpreted as contrasting with another non-constituent *KONPYÛTA o tsukatta* 'used a computer', and thus is arguably a non-constituent focus. Likewise, in (5), the non-constituent *KOE ga kikoeta* 'voice was heard' appears to be interpreted as contrasting with another non-constituent *KAO ga mieta* 'face was seen', and thus is arguably a non-constituent focus.[4] What is to be noted here is that neither the verb *itta* in (4) nor the verb *kikoeta* in (5) is prosodically prominent, contrary to what Pulman's theory leads us to expect; according to his theory, what looks like a non-constituent focus in (4) for instance is merely a sequence of a focused noun and a focused verb, so the verb is expected to be prosodically prominent as well as the noun, given the reasonable assumption that each focus must contain at least one prosodically prominent word.

contains a mora that is lexically linked to a high tone. See Pierrehumbert and Beckman (1988) and Kubozono (1993) for more information on this subject.

[3]See Pierrehumbert and Beckman (1988) and Kubozono (1993) for detailed discussion of downstep (which Pierrehumbert and Beckman refer to as catathesis).

[4]The particle *wa*, which we have glossed as TOP, is in fact functioning not as a topic marker but as a contrastive marker in these examples; for instance, in (4), the two phrases that are marked by *wa* (namely *Sutanfôdo no konpyûta o tsukatta koto* and *Sutanfôdo no kyanpasu e itta koto*) are being contrasted with each other. It seems reasonable to suppose that, in the terminology employed in Krifka (to appear), the phrases marked by the particle *wa* are functioning as "focus phrases", as opposed to foci. We will ignore complications resulting from the presence of focus phrases in the rest of this paper, for the sake of simplicity.

A number of authors have expressed the view that it is possible for a focus to contain some elements that are contextually bound ("given") and hence deaccented. If such a view is adopted, it becomes possible to analyze sentences like (4) and (5) in the following way: what is focused in (4) (or (5) respectively) is the VP *Sutanfôdo no kyanpasu e itta* as a whole (or the S *Hanako no koe ga kikoeta* as a whole) and the genitive phrase *Sutanfôdo no* (or *Hanako no*) is part of the focus, although it is contextually bound ("given") and hence deaccented. We do not know whether Pulman would endorse such an analysis, but this seems to be one possible way to deal with the problematic examples within his theory.

However, we find such an analysis implausible, in light of observations like the following. Even in a context that makes Hanako salient, it is not possible to felicitously utter the unparenthesized portion of (5) if the whole S is to be interpreted as contrasting with an alternative which does not involve any direct or indirect reference to Hanako.

(6) Hanako wa tonari no ie ni sunde iru. Mado ga aite iru koto wa yoku aru. Demo, Hanako no koe ga kikoeta koto wa ichido mo nai.
('Hanako lives in the house next door. There have been many occasions when the window was open. But there has never been an occasion when Hanako's voice was heard.')

The last sentence in (6) is felicitous only if the noun *Hanako* is at least as prosodically prominent as the following noun *koe*, even though Hanako is a salient individual in the given context; the pronunciation indicated in (5) cannot be used in this context. This suggests that what is focused in (5) above is not the same as what is focused in the last sentence of (6). Since what is focused in the last sentence of (6) is arguably the S *Hanako no koe ga kikoeta* as a whole, this means that what is focused in (5) is not the S as a whole.

1.2 Schwarzschild (1999)

Schwarzschild (1999) presents a theory of focus that is based on a sophisticated notion of givenness. In his theory, an expression is considered to be given if there is something in the preceding discourse that corresponds either to that expression itself or to the result of replacing each focused element in that expression with some suitable alternative. Consider the example in (7).

(7) "Did you go to New York?" "No, I went to $[_F$ CHICAGO]."

In the second sentence in this discourse, the NP *Chicago* is focused, and not given. The PP containing that NP (i.e. *to Chicago*) counts as given, however, according to Schwarzschild's definition, because replacing the focused element *Chicago* in this PP with a suitable alternative (*New York*) results in a PP (*to New York*) that is identical to the PP that is in the preceding sentence.

Schwarzschild assumes that each node in a syntactic tree is optionally associated with F-marking, and that F-marking is subject to the following set of violable constraints, ranked as shown in (10).

(8) GIVENness: A constituent that is not F-marked is given.
AVOIDF: Do not F-mark.
FOC: A Foc-marked phrase contains an accent.
HEADARG: A head is less prominent than its internal argument.

(9) A Foc-marked node is an F-marked node that is not immediately dominated by another F-marked node.

(10) { GIVENness, FOC } >> AVOIDF >> HEADARG

In Schwarzschild's theory, the second sentence in (11), for example, is dealt with in the following way.

(11) { What will they do if the American President resigns from the OSA? }
They'll $[_F$ $[_F$ nominate] the $[_F$ FRENCH] President]

Within the VP in this sentence, the verb *nominate* and the adjective *French* are both F-marked, but only the latter is accented. This is because the latter is not immediately dominated by another F-marked node and is hence Foc-marked, and is required to contain an accent by FOC, whereas the former (*nominate*) is immediately dominated by an F-marked VP, and hence is not Foc-marked.

In Schwarzschild's theory, as in Pulman's theory, focus is always a syntactic constituent. Thus, in order to deal with example (4) within this theory, for instance, it is necessary to assume that what is focused in the sentence is the VP *Sutanfôdo no KYANPASU e itta* as a whole, and the phrase *Sutanfôdo no* is part of that focus, although it is given. As we stated in the previous subsection, we believe that there is a reason to be skeptical about such an assumption. Moreover, an analysis based on an assumption like this faces an additional problem when embedded within Schwarzschild's theory, if only because his theory is more explicit than Pulman's in the relevant domain. Consider the following example.

(12) — Kimi wa [[Naomi ga suki na] KARÊ o] tsukutta n
you TOP [[Naomi NOM fond COP] curry ACC] make-PAST NML
datte?
COP-COMP
— Ie, boku wa [[Naomi ga suki na] DÔYÔ o] utatta
no I TOP [[Naomi NOM fond COP] children's song ACC] sing-PAST
n desu.
NML COP
'Did you make the curry which Naomi likes?' 'No, I sang a children's song that Naomi likes.'

Intuitively, the non-constituent *DÔYÔ o utatta* seems to be functioning as focus, but suppose that the focus in the second sentence is in fact the VP *Naomi ga suki na DÔYÔ o utatta* as a whole and that the phrase *Naomi ga suki na*, which counts as given, is part of that focus. On such a supposition, the internal structure of that VP must be something like (13).

(13) [[[[Naomi ga suki na] [$_F$ DÔYÔ]] o] [$_F$ utatta]]

It must be the case that the noun *DÔYÔ* and the verb *utatta*, and nothing else, is F-marked. What is of particular importance here is that the VP as a whole cannot be F-marked. This is because the VP counts as given, according to Schwarzschild's definition (and AVOIDF prevents an expression that counts as given from being F-marked unless some higher-ranking constraint demands that it be F-marked); it counts as given because the VP becomes identical to another VP in the discourse (*Naomi ga suki na karê o tsukutta*) when the two focused elements in it are replaced by *karê* and *tsukutta* respectively. This is problematic for the theory, for the following reason. Since the verb *utatta* is F-marked and is not immediately dominated by another F-marked node, it is Foc-marked and is required by the constraint FOC to contain a prosodically prominent element. Thus, Schwarzschild's theory predicts, wrongly, that the verb in an example of this type must be prosodically prominent.[5]

2 Compaction-driven meaning assembly

We believe that the facts that we have surveyed in section 1 call for a theory in which a non-constituent (in the morphosyntactic sense) is allowed to serve as a single focus, rather than merely as a sequence of two or more foci. If that is so, we need a theoretical framework in which what is not a morphosyntactic constituent can be given semantic interpretation.[6] There are two theories of semantic composition that fit the bill: Combinatory Categorial Grammar (CCG), extensively discussed in Steedman (2000), and the version of linearization-based Head-Driven Phrase Structure Grammar (HPSG) proposed in Yatabe (2001). Both these theories embody the idea that semantic composition is carried out largely on the basis of prosodic, rather than syntactic, structure. In Steedman's theory, each sentence is associated with a single representation which closely resembles what is usually assumed to be its prosodic structure, and semantic interpretation is carried out according to that single representation. On the other hand, in Yatabe's theory, each sentence is associated with multiple representations, only one of which resembles what is usually assumed to be its prosodic structure, and semantic interpretation is carried out mainly on the basis of that structure. The theory can be seen as an attempt to capture Steedman's insights without denying the existence of what

[5] Krifka (in press) makes an analogous criticism of Schwarzschild's theory, using English examples that do not involve non-constituent focus.

[6] Artstein (2004) advocates a view similar to ours for focus below the word level but not for focus above the word level.

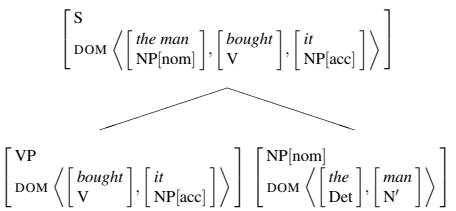

Figure 1: Total compaction of an NP

is widely assumed to be the morphosyntactic structure of each sentence. In the remainder of this paper, we rely on Yatabe's theory of semantic composition, as we feel that CCG, though attractively simple, may not allow us to attain descriptive adequacy with regard to phenomena such as those discussed in Yatabe (2003). However, of the two theories, Steedman's theory is clearly the more elegant, and it is entirely conceivable that a theory analogous to ours could be implemented within CCG as well.

Since the theory advanced in Yatabe (2001) builds on the theory of extraposition proposed in Kathol and Pollard (1995), we will sketch the latter theory before describing the former.

In Kathol and Pollard's theory, the portion of a syntactic structure that determines grammatical dependency relations is represented by means of an unordered tree, that is, a tree with no specifications as to the ordering of its constituents. The information as to the linear order between the constituents is contained in what are called *order domains*, each of which is associated with a node in the unordered tree. An order domain is a list of *domain objects*, and is given as the value of the DOM feature. A domain object is very much like a sign; unlike a sign, however, it does not carry any information as to its internal morphosyntactic structure.

Let us take a concrete example. Figure 1 shows part of the structure assigned to the English sentence *The man bought it*. What is shown in this figure is an unordered tree. There is actually no linear precedence relation between the VP node and the NP node; we placed the VP node to the left of the subject NP node in order to underscore the insignificance of the apparent linear order between the two. The order domain (i.e. the DOM value) of the VP node consists of two domain objects, one that is pronounced *bought*, and the other one that is pronounced *it*. The order between these two domain objects *is* significant; it indicates that this VP is to be pronounced *bought it*, rather than *it bought*. Likewise, the order domain of the NP node tells us that this NP is to be pronounced *the man*, and the order domain of the S node tells us that the S node is to be pronounced *The man bought it*.

Let us take a closer look and see how the order domain of the S node is related to the order domains of the NP node and the VP node in Figure 1. The two domain objects in the order domain of the VP node are both integrated, unaltered, into

the order domain of the S node. Notice that the domain object that is pronounced *bought* precedes the domain object that is pronounced *it* in the order domain of the S as well as in the order domain of the VP. This is a consequence of the constraint given in (14) (see Kathol (1995)).

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

Next, let us see how the order domain of the NP is related to the order domain of the S in Figure 1. The order domain of the NP node contains two domain objects, but this NP node contributes to the order domain of the S node only one domain object, which is pronounced *the man*. What is at work here is an operation called *total compaction*. (15) illustrates the way the total compaction operation takes a sign and turns it into a single domain object.

$$(15)\quad \left[\begin{array}{l}\alpha_0\\ \textsc{dom}\left\langle \left[\begin{array}{l}\beta_1\\ \alpha_1\end{array}\right],\ldots,\left[\begin{array}{l}\beta_n\\ \alpha_n\end{array}\right]\right\rangle\end{array}\right] \Rightarrow \left[\begin{array}{l}\beta_1\circ\cdots\circ\beta_n\\ \alpha_0\end{array}\right]$$

What is shown on the left of the arrow is the input to the operation; the input is a sign. The first line of a sign ("α_0" in this case) is its SYNSEM value; the second line ("DOM ...") shows what its order domain looks like. On the right of the arrow is shown the output of the operation; the output is a domain object. The first line of a domain object ("$\beta_1\circ\cdots\circ\beta_n$" in this case) is its PHON value. (The small circle is an operator that concatenates strings.) The second line of a domain object ("α_0" in this case) is its SYNSEM value.

The domain object that is created by totally compacting a sign X is placed in the order domain of the mother of X. In Figure 1, the domain object that is created by totally compacting the subject NP has been placed in the order domain of the S.

The order between the domain object that comes from the subject NP and the domain objects that come from the VP is determined by a linear precedence statement that states that a V must follow its subject in English. Although domain objects coming from two or more daughter nodes can be stringed together in any order as long as they do not violate any constraints explicitly stated in the grammar, the order between the three domain objects is completely determined in this case, due to the Persistence Constraint and the linear precedence statement concerning subject NPs.

So far, we have seen two processes whereby the order domain of a given node is integrated into that of its mother. First, a node can be totally compacted. Second, a node may undergo no compaction whatsoever. Henceforth we are going to describe the latter situation by saying that the node in question has been *liberated*. The VP in Figure 1 has been liberated.

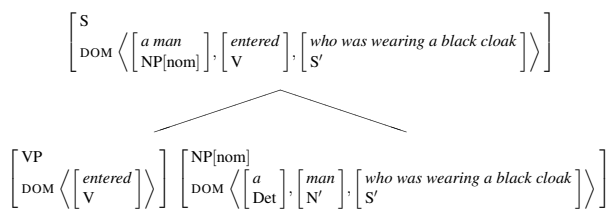

Figure 2: Partial compaction of an NP

There is a third process allowed by the theory: a given node can be *partially compacted*. Partial compaction takes a sign and turns it into one or more domain objects, as opposed to total compaction, which always produces a single domain object. (As will become clear shortly, total compaction can be seen as a special case of partial compaction.) (16) and (17) illustrate the way the partial compaction operation takes a sign and turns it into one or more domain objects, which are to be placed in the order domain of the mother of that sign.

(16) Partial compaction for head-first languages:
$$\left[\begin{array}{l}\alpha_0\\ \textsc{dom}\left\langle \left[\begin{array}{l}\beta_1\\ \alpha_1\end{array}\right],\ldots,\left[\begin{array}{l}\beta_n\\ \alpha_n\end{array}\right]\right\rangle\end{array}\right] \Rightarrow \left[\begin{array}{l}\beta_1\circ\cdots\circ\beta_i\\ \alpha_0\end{array}\right],\left[\begin{array}{l}\beta_{i+1}\\ \alpha_{i+1}\end{array}\right],\ldots,\left[\begin{array}{l}\beta_n\\ \alpha_n\end{array}\right]$$

(17) Partial compaction for head-last languages:
$$\left[\begin{array}{l}\alpha_0\\ \textsc{dom}\left\langle \left[\begin{array}{l}\beta_1\\ \alpha_1\end{array}\right],\ldots,\left[\begin{array}{l}\beta_n\\ \alpha_n\end{array}\right]\right\rangle\end{array}\right] \Rightarrow \left[\begin{array}{l}\beta_1\\ \alpha_1\end{array}\right],\ldots,\left[\begin{array}{l}\beta_{i-1}\\ \alpha_{i-1}\end{array}\right],\left[\begin{array}{l}\beta_i\circ\cdots\circ\beta_n\\ \alpha_0\end{array}\right]$$

In (16), the DOM value of the sign that is fed to the operation as the input has n domain objects in it. Of those domain objects, the first (i.e. leftmost) i domain objects are bundled together and turned into a single domain object, while the remaining domain objects, if any, are left out of the bundle and continue to be separate domain objects. (17) is a mirror image of (16). Roughly speaking, partial compaction of a sign α is achieved by first obtaining a sign α' by deleting a certain number of domain objects in the DOM value of α (the rightmost $n-i$ domain objects in the case of (16) and the leftmost $i-1$ domain objects in the case of (17)) and then totally compacting α'.

Various types of extraposition constructions result when an expression is partially compacted and surfaces as a discontinuous constituent. Figure 2 shows how the English extraposition construction can be generated via partial compaction. Here, the subject NP has been partially compacted. The relative clause has been left out of the bundle and appears in the sentence-final position. What puts the relative clause in this particular position is an English-particular linear precedence statement, which we do not formulate in this paper.

We assume that the compaction operation is applied in accordance with the constraints given in (18) (see Yatabe (2001)).

(18) a. In a head-complement structure whose head is verbal, the head is liberated and the non-head is partially compacted.

b. In a head-adjunct structure whose head is verbal, the head and the adjunct are both partially compacted.

c. In a headed structure whose head is nominal and whose non-head is not a marker, the head is totally compacted and the non-head is partially compacted.

d. In a head-marker structure, the head and the marker are both liberated.

e. In a coordinate structure, each of the conjuncts is totally compacted.

On these assumptions, domain objects turn out to correspond rather closely to what have been identified as prosodic constituents in the relevant literature.

We are now in a position to describe the theory of semantic composition presented in Yatabe (2001). The key idea of this theory is that domain objects, and not signs (i.e. morphosyntactic constituents), are the principal carriers of semantic information and that semantic composition (including 'quantifier retrieval') takes place not when some signs are syntactically combined to produce a new, larger sign but when some domain objects are bundled together by the compaction operation to produce a new domain object. In order to implement this idea, the framework of Minimal Recursion Semantics (MRS) (Copestake et al. (1999)) is adopted, and the *total compaction* operation is redefined as in (19).

(19)
$$\left[\begin{array}{l}\textit{sign}\\ \textsc{synsem}\left[\begin{array}{l}\textsc{cat}\ \boxed{3}\ [\textsc{to-be-stored}\ \boxed{4}]\\ \textsc{cont}\left[\begin{array}{ll}\textsc{ltop} & \boxed{0}\\ \textsc{index} & \boxed{1}\\ \textsc{semhead} & \boxed{2}\\ \textsc{ep} & \boxed{a_0}\\ \textsc{h-cons} & \boxed{b_0}\\ \textsc{h-store} & \boxed{c_0}\end{array}\right]\end{array}\right]\\ \textsc{dom}\left\langle\left[\begin{array}{ll}\textsc{phon} & \boxed{d_1}\\ \textsc{synsem}|\textsc{cont} & \left[\begin{array}{ll}\textsc{ep} & \boxed{a_1}\\ \textsc{h-cons} & \boxed{b_1}\\ \textsc{h-store} & \boxed{c_1}\end{array}\right]\end{array}\right],\cdots,\left[\begin{array}{ll}\textsc{phon} & \boxed{d_n}\\ \textsc{synsem}|\textsc{cont} & \left[\begin{array}{ll}\textsc{ep} & \boxed{a_n}\\ \textsc{h-cons} & \boxed{b_n}\\ \textsc{h-store} & \boxed{c_n}\end{array}\right]\end{array}\right]\right\rangle\end{array}\right]$$
$$\Rightarrow\left[\begin{array}{l}\textit{dom-obj}\\ \textsc{phon}\quad f\left(\boxed{d_1},\cdots,\boxed{d_n}\right)\\ \textsc{synsem}\left[\begin{array}{l}\textsc{cat}\ \boxed{3}\\ \textsc{cont}\left[\begin{array}{ll}\textsc{ltop} & \boxed{0}\\ \textsc{index} & \boxed{1}\\ \textsc{ep} & \boxed{a_0}\oplus\cdots\oplus\boxed{a_n}\\ \textsc{h-cons} & \boxed{b_0}\cup\cdots\cup\boxed{b_n}\cup\left\{\boxed{0}\geq\left\{\boxed{2}\right\}\uplus\boxed{c_0}\uplus\cdots\uplus\boxed{c_n}\right\}\\ \textsc{h-store} & \boxed{4}\end{array}\right]\end{array}\right]\end{array}\right]$$

The definition in (19) is admittedly somewhat complicated, and we have to refer the reader to Yatabe (2001) for a full explication of its details. Fortunately, in this paper, we can all but ignore all the CONT features except EP and INDEX, since the CONT features other than EP and INDEX are there to determine the semantic scope of things like quantifiers in an appropriate manner and determination of scope is not one of the main issues that we are concerned with in the present paper. The feature EP is essentially what is called RESTR in Sag et al. (2003), and corresponds to what is called LZT in Copestake et al. (1999); the value of this feature is the list of *elementary predications* that make up the meaning of a given linguistic unit, be it a sign or a domain object. The feature INDEX in the proposed theory plays the same role as it does in Sag et al. (2003), and is assumed to be subject to what is called the Semantic Inheritance Principle in Sag et al. (2003).

If we pay attention only to the EP feature, it is apparent that the definition of total compaction above closely resembles what is called the Semantic Compositionality Principle in Sag et al. (2003). The Semantic Compositionality Principle states that the RESTR value of a phrase must be the concatenation of the RESTR values of its daughters. (19) above states, roughly, that the EP value of a domain object that results from totally compacting a sign α must be the concatenation of the EP values of the domain objects inside the order domain of α.[7]

Partial compaction of a sign α is, again, assumed to be achieved by first obtaining a sign α' by deleting a certain number of domain objects (the rightmost one(s) in the case of head-first languages like English) in the DOM value of α and then totally compacting α'. For example, in the structure depicted in Figure 2, partial compaction of the subject NP can be seen as involving the following 'steps'. First, the rightmost domain object in the order domain of the subject NP, namely the domain object that is to be pronounced *who was wearing a black cloak*, is deleted. This gives us a sign like (20).

(20)
$$\left[\begin{array}{ll}\textsc{synsem} & \left[\begin{array}{ll}\textsc{cat} & \textsc{np[nom]}\\ \textsc{cont} & \left[\begin{array}{ll}\textsc{index} & \boxed{3}\\ \textsc{ep} & \langle\,\rangle\end{array}\right]\end{array}\right]\\ \textsc{dom} & \left\langle\left[\begin{array}{ll}\textsc{phon} & \textit{a}\\ \textsc{synsem} & \left[\begin{array}{ll}\textsc{cat} & \textsc{det}\\ \textsc{cont}|\textsc{ep} & \langle\boxed{1}\rangle\end{array}\right]\end{array}\right],\left[\begin{array}{ll}\textsc{phon} & \textit{man}\\ \textsc{synsem} & \left[\begin{array}{ll}\textsc{cat} & \textsc{n}'\\ \textsc{cont}|\textsc{ep} & \langle\boxed{2}\rangle\end{array}\right]\end{array}\right]\right\rangle\end{array}\right]$$

Second, this sign undergoes total compaction, and is turned into a domain object like (21), which is to be placed in the order domain of the mother node together with the domain object that was deleted in the first 'step' as well as the domain object that comes from the VP node.

[7] To be more precise, (19) says that the EP value of a domain object that results from totally compacting a sign α must be the concatenation of the EP value of α itself and the EP values of the domain objects inside the order domain of α. In the theory under discussion, the EP value of a sign ($\boxed{a_0}$ in (19)) is assumed to represent only constructional meaning, that is, meaning that is expressed not by individual words but by grammatical constructions. In the present paper, we make reference to constructional meaning only in (27).

(21)
$$\begin{bmatrix} \text{PHON} & \textit{a man} \\ \text{SYNSEM} & \begin{bmatrix} \text{CAT} & \text{NP[nom]} \\ \text{CONT} & \begin{bmatrix} \text{INDEX} & \boxed{3} \\ \text{EP} & \langle \boxed{1}, \boxed{2} \rangle \end{bmatrix} \end{bmatrix} \end{bmatrix}$$

In (20) and (21), the referent of $\boxed{1}$ is something like (22a) and the referent of $\boxed{2}$ is something like (22b). They are the semantic contributions of the word *a* and the word *man* respectively.

(22) a.
$$\begin{bmatrix} \text{HNDL} & \boxed{4} \\ \text{RELN} & \textit{a} \\ \text{BV} & \boxed{5} \\ \text{RESTR} & \boxed{6} \\ \text{BODY} & \boxed{7} \end{bmatrix}$$
b.
$$\begin{bmatrix} \text{HNDL} & \boxed{6} \\ \text{RELN} & \textit{man} \\ \text{INST} & \boxed{5} \end{bmatrix}$$

It is assumed in this theory that the root node of a sentence always undergoes total compaction to produce a single domain object corresponding to the entire sentence. This assumption is necessary to ensure that the meaning of the root node is in fact computed. For instance, the root node of the tree shown in Figure 2 has three domain objects in its order domain, each with its own interpretation (not shown in the figure), but none of these three domain objects represents the meaning of the entire sentence. The meaning of the sentence as a whole is represented only by the SYNSEM|CONT(ENT) value and the SYNSEM|CONTEXT value of the domain object that is obtained by totally compacting the root node.

In the proposed theory, it is not signs but domain objects that are assigned interpretation; domain objects, but not signs, are associated with CONT values that can be said to represent their meaning. Since domain objects are essentially prosodic constituents and do not necessarily correspond to morphosyntactic constituents because of the possibility of partial compaction, it follows that it is possible in this theory for a string that is not a morphosyntactic constituent to be assigned interpretation. It is this feature of the theory that we are going to exploit in the next section.

3 An MRS-based theory of focus

In this section, we will use the theoretical machinery just described to construct a theory of focus that is capable of dealing with non-constituent focus. We will achieve this goal by incorporating into our theory a version of the Structured Meaning approach to the interpretation of focus (see Krifka (in press) and the references cited there).

We propose to enrich the CONT values of domain objects with two new features, FOCI and PROMINENCE (FOC and PROM for short). The FOC value of a domain object is a set whose members are the EP values of all the foci that are contained in that domain object. PROM is a binary-valued feature that is used to

deal with focus projection; a domain object is marked as +PROM if and only if (i) it contains (or is) a prosodically prominent element and (ii) it is a part of a focus but is not a focus in itself. (33) and (34) in the Appendix state the constraints that implement what has just been said about these two features.

In the case of an example like (23), the FOC value of the domain object corresponding to the entire sentence will be something like (24), if focus projection does not take place at all; it is a set consisting of two members, the EP value of the first focus *Paris* and the EP value of the second focus *hates*.

(23) George only likes PARIS and he HATES New York.

(24)
$$\left\{ \left\langle \begin{bmatrix} \text{HNDL} & \boxed{1} \\ \text{RELN} & \textit{Paris} \\ \text{INST} & \boxed{2} \end{bmatrix} \right\rangle, \left\langle \begin{bmatrix} \text{HNDL} & \boxed{3} \\ \text{RELN} & \textit{hate} \\ \text{HATER} & \boxed{4} \\ \text{HATED} & \boxed{5} \end{bmatrix} \right\rangle \right\}$$

Likewise, if focus projection takes place only in the first conjunct and the pitch accent on *Paris* is taken to focus the VP *likes Paris*, then the FOC value of the domain object corresponding to (23) as a whole will be something like (25), a set consisting of the EP value of the first focus *likes Paris* and the EP value of the second focus *hates*.

(25)
$$\left\{ \left\langle \begin{bmatrix} \text{HNDL} & \boxed{6} \\ \text{RELN} & \textit{like} \\ \text{LIKER} & \boxed{7} \\ \text{LIKED} & \boxed{2} \end{bmatrix}, \begin{bmatrix} \text{HNDL} & \boxed{1} \\ \text{RELN} & \textit{Paris} \\ \text{INST} & \boxed{2} \end{bmatrix} \right\rangle, \left\langle \begin{bmatrix} \text{HNDL} & \boxed{3} \\ \text{RELN} & \textit{hate} \\ \text{HATER} & \boxed{4} \\ \text{HATED} & \boxed{5} \end{bmatrix} \right\rangle \right\}$$

We follow Pulman (1997) in assuming that focus-sensitive operators such as *only* and *even* take the following two arguments: (i) a list of focused elements that are to be interpreted in association with the operator, and (ii) what the meaning of the scope of that operator would have been if the focused elements that are to be interpreted in association with that operator had not been focused (see subsection 1.1 above). We represent these two arguments as the values of the ASSOCIATED-FOCI (A-FOC) feature and the SCOPE feature respectively inside elementary predications corresponding to focus-sensitive operators. In such an approach, we need to have a mechanism that ensures that each focus-sensitive operator is correctly associated with those focused elements that are to be interpreted in association with it, and another mechanism that ensures that each focus-sensitive operator is correctly linked to its scope. We will specify these mechanisms next, starting with the latter.

Unlike the scope of a quantifier, the scope of a focus-sensitive operator such as *only* is rigidly fixed; the scope of a focus-sensitive adverb like *only* and *even* is arguably always the meaning of its sister node, and the scope of an illocutionary operator like the assertion operator *assert* (see Krifka (1991)) is the meaning of the clausal node at which the operator is introduced. These constraints can be enforced via the canonical HPSG machinery. For instance, a lexical entry like (26)

is sufficient to ensure that focus-sensitive adverbs are assigned the correct scope. LTOP, one of the CONT features that we ignored in section 2, provides a label (a 'handle') by which to refer to the meaning of a sign or a domain object. Thus, the identity requirement indicated by [1] in (26) forces the scope of the word *only* (i.e. its SYNSEM|CONT|EP|FIRST|SCOPE value) to be the meaning of the VP that it modifies.

(26)
$$\begin{bmatrix} \text{SYNSEM} & \begin{bmatrix} \text{CAT|VALENCE|MOD} & \left\langle \begin{bmatrix} \text{CAT} & \text{VP} \\ \text{CONT|LTOP} & \boxed{1} \end{bmatrix} \right\rangle \\ \text{CONT|EP} & \left\langle \begin{bmatrix} \text{RELN} & \textit{only} \\ \text{A-FOC} & \boxed{\text{F1}} \\ \text{SCOPE} & \boxed{1} \end{bmatrix} \right\rangle \end{bmatrix} \\ \text{PHON} & \text{/ounli:/} \end{bmatrix}$$

Likewise, the assertion operator *assert* can be assigned the correct scope by a unary rule like (27).

(27)
$$\begin{bmatrix} \text{SYNSEM} & \begin{bmatrix} \text{CAT} & \boxed{1} \\ \text{CONT} & \begin{bmatrix} \text{LTOP} & \boxed{3} \\ \text{INDEX} & \boxed{4} \\ \text{EP} & \left\langle \begin{bmatrix} \text{HNDL} & \boxed{3} \\ \text{RELN} & \textit{assert} \\ \text{A-FOC} & \boxed{\text{F2}} \\ \text{SCOPE} & \boxed{2} \end{bmatrix} \right\rangle \\ \text{MODE} & \textit{assertion} \end{bmatrix} \end{bmatrix} \\ \text{DOM} & \boxed{5} \end{bmatrix}$$
$$\longrightarrow \begin{bmatrix} \text{SYNSEM} & \begin{bmatrix} \text{CAT} & \boxed{1}\text{S} \\ \text{CONT} & \begin{bmatrix} \text{LTOP} & \boxed{2} \\ \text{INDEX} & \boxed{4} \\ \text{MODE} & \textit{proposition} \end{bmatrix} \end{bmatrix} \end{bmatrix}$$

Condition: [5] is a result of partially compacting the sole daughter.

The identity requirement indicated by [2] forces the scope of the assertion operator (the SYNSEM|CONT|EP|FIRST|SCOPE value associated with the mother node) to be the meaning of the sole daughter node, which is required to be an S node. In the case of (23), there are three S nodes at which the assertion operator can be introduced: the root node, the first conjunct, and the second conjunct. We are not certain whether introduction of the assertion operator is entirely optional at each S node or not, but here we assume that it is, for the sake of concreteness.

As a mechanism for ensuring appropriate association between foci and focus-sensitive operators, we suggest the following. The MRS-based semantic representation of an utterance (namely the CONT value of the domain object obtained by totally compacting the entire sentence) leaves the association between foci and focus-sensitive operators completely unspecified. Thus, in the proposed theory (as in many other theories that incorporate the idea of underspecified semantic representations), each semantic representation corresponds not just to a single interpretation of a given sentence but rather to a set of its possible interpretations. The set

of possible interpretations of a given sentence is computed from its underspecified semantic representation in accordance with the constraints given in (28).

(28) a. Every focus-sensitive operator must be associated with one or more foci, and every focus must be associated with a focus-sensitive operator.

b. A focus can be associated with a focus-sensitive operator only if it is within the scope of that focus-sensitive operator.

Both (28a) and (28b) are stated in informal terms, and need some further elaboration. (28a) presupposes that it is possible to identify focus-sensitive operators in a given semantic representation. In order to make this possible, we assume that only elementary predications corresponding to focus-sensitive operators have the A-FOC feature. Given that assumption, (28a) can be construed as requiring each A-FOC feature to be linked to one or more of the foci contained in a sentence. (28b) as it stands may seem somewhat vague because the phrase *within the scope of* has not been given a definition. The phrase is intended to mean what it means in the case of the more traditional types of semantic representation. A more precise definition of the phrase is given in (36) in the Appendix.

We will illustrate the way these constraints work in the case of example (23). Let us assume that no focus projection has taken place, and that the FOC value of the entire sentence is therefore something like (24). Let us also assume that the assertion operator has been introduced at the second S node and nowhere else. In that case, we have two foci and two focus-sensitive operators in the semantic representation of the sentence. Although the semantic representation does not indicate which focus is associated with which focus-sensitive operator, the constraints in (28) entail that there is only one possible way to link the foci and the operators. Due to (28a), we know that each operator needs to be associated with exactly one focus in the present case. Furthermore, (28b) does not allow the focus *Paris* to be associated with the assertion operator which takes the second S as its scope, as the focus is not within that scope. The two constraints are satisfied if and only if *Paris* is associated with *only* and *hates* is associated with the assertion operator.[8] A similar result will follow if we assume that the assertion operator is introduced at the root node and nowhere else. If the assertion operator is introduced in any other way, the resultant semantic representation will have no possible interpretation, and the representation will be ruled out as ill-formed.

Let us see what interpretations the proposed theory assigns to sentences containing foci. We will take the second conjunct of (23) (*he HATES New York*) as an example. As shown at length in Rooth (1992), the truth condition of a sentence containing foci can be determined only relative to what alternatives the foci are interpreted as contrasting with. Supposing that the focus *hates* (the second member

[8] The HNDL value of the proper noun *Paris* must be allowed to be different from the top handle of the entire sentence. If the HNDL value of a proper noun is always required to be the same as the top handle of the whole sentence, a focused proper noun will never be able to be within the scope of any focus-sensitive operator.

in (24) as well as in (25)) is interpreted as contrasting with something like (29) (and supposing also (i) that the assertion operator is interpreted roughly as in Pulman (1997) and (ii) that all underspecifications are resolved before foci are interpreted), the interpretation of the clause is predicted to be something like "The proposition that he hates New York, as opposed to the proposition that he likes it, is true", which is arguably what the clause actually means in (23).

(29) $\left\langle \begin{bmatrix} \text{HNDL} & \boxed{3} \\ \text{RELN} & \textit{like} \\ \text{LIKER} & \boxed{4} \\ \text{LIKED} & \boxed{5} \end{bmatrix} \right\rangle$

However, here we encounter a problem. Nothing in the theory ensures that the "correct" alternative shown in (29) is properly made salient by the context. For instance, nothing in the theory as it stands prevents the focus *hates* from being interpreted as contrasting with (30) instead of (29).

(30) $\left\langle \begin{bmatrix} \text{HNDL} & \boxed{3} \\ \text{RELN} & \textit{hate} \\ \text{HATER} & \boxed{4} \\ \text{HATED} & \boxed{2} \end{bmatrix} \right\rangle$

Since the indices $\boxed{4}$ and $\boxed{2}$ refer to George and to Paris respectively, (30) carries the meaning of George hating Paris. Consequently, if *hates* in the second clause of (23) is interpreted as contrasting with this alternative, the interpretation of the clause will end up being something like "The proposition that George hates New York, as opposed to the proposition that he hates Paris, is true". This interpretation is a possible interpretation of a sentence like *George hates NEW YORK*, but it is not a possible interpretation of the clause under discussion, where it is not the object NP but the transitive verb that is under focus.

In order to circumvent this problem and some other related problems, we introduce two constraints on the kinds of alternatives that a focus can be contrasted with. One is stated in (31) below and the other is stated in (37) in the Appendix. (We defer stating the latter constraint until the Appendix because it makes reference to aspects of MRS that we chose not to introduce in section 2.)

(31) Suppose that a focus X, which is a non-empty list of elementary predications, is to be interpreted as contrasting with another non-empty list of elementary predications, Y. Then any tag that appears both in an elementary predication inside X and in an elementary predication outside X must appear in one or more elementary predications inside Y.

According to this constraint, (30) is not a valid alternative to the second member of (24) because it does not contain the tag $\boxed{5}$. Notice that, in the MRS representation of the meaning of (23), $\boxed{5}$ appears both in an elementary predication that comes

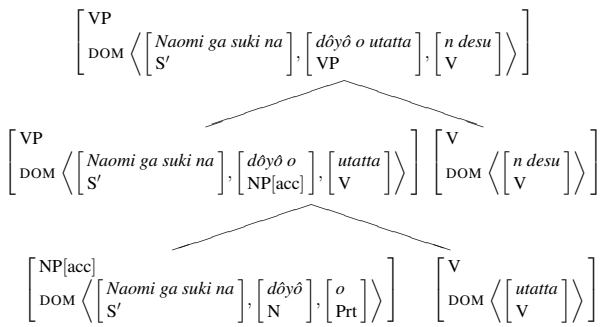

Figure 3: One possible structure of part of (12)

from the focused verb and in the elementary predication that comes from the object NP *New York*.

Furthermore, we assume that no two NPs are assigned the same index; even a reflexive pronoun and its antecedent must be given different indices in our theory. We assume that what is achieved by coindexation in other theories is achieved by introducing into meaning representations (into the SYNSEM|CONTEXT values of domain objects corresponding to pronouns, more specifically) statements to the effect that an index α and another index β are to be mapped to the same object by every value assignment function. This assumption enables our theory to deal with an example like the following, where a reflexive pronoun is focused. If it were not for this assumption, the verb *criticized* would contribute to the MRS representation of the second sentence as a whole an elementary predication that says "He criticized himself", and that would rigidly fix the meaning of the sentence no matter what alternative is substituted for the elementary predication that comes from the object NP *himself*.

(32) John didn't criticize Thomas. He criticized HIMSELF.

We finally come back to the issue of non-constituent focus. In the proposed account, the value of the FOC feature is a set consisting of the EP values of domain objects. Domain objects are prosodic constituents, and do not necessarily correspond to morphosyntactic constituents, due to the possibility of partial compaction. Therefore the theory entails that a string can be focused even if it does not form a morphosyntactic constituent, as long as it forms a prosodic constituent. Thus, the theory has no difficulty handling cases like (4), (5), and (12). Here we use (12) to illustrate the way the theory handles non-constituent focus. Figure 3 shows one possible structure of the VP *Naomi ga suki na dôyô o utatta* in (12). Note how repeated applications of partial compaction give rise to a domain object

pronounced *dôyô o utatta*, which does not correspond to any morphosyntactic constituent. When the noun *dôyô* is prosodically prominent, this domain object as a whole can be interpreted as a single focus, as a result of focus projection.

4 Conclusion

In this paper, we have argued, mainly on the basis of Japanese data, that we need to have a theory of focus in which a non-constituent (in the morphosyntactic sense) is allowed to serve as a single focus, rather than merely as a sequence of two or more foci, and then presented such a theory within the framework of linearization-based HPSG. In the proposed theory, prosodic constituents (domain objects), rather than morphosyntactic constituents (signs), are claimed to be the principal carriers of semantic information, and meaning assembly is carried out on the basis of prosodic, rather than syntactic, structure. This theory, if correct, means that there is a certain dissociation between the morphosyntactic structure of a sentence and the way the meaning of the sentence is assembled. Thus, to the extent that morphosyntactic structure is viewed as "the way the parts of a sentence are put together", the theory is inconsistent with the principle of compositionality, which states that the meaning of a complex expression is a function of the meaning of its parts and the way they are put together; in order to maintain the principle of compositionality, we need to regard prosodic constituents, as opposed to morphosyntactic constituents, as building blocks of sentence meanings.

Appendix

(33) and (34) state the constraints that govern the FOC value and the PROM value of a domain object.[9] The term *d-argument*, used in (34), is defined in (35). The details of these definitions apply only to Japanese, and are not meant to be universal.

(33) Suppose that a domain object d is a member of the order domain of a word (i.e. a leaf node in a syntactic tree).

a. If the word is not prosodically prominent, then the FOC value of d is an empty set and the PROM value of d is $-$.
b. If the word is prosodically prominent, then either
   i) the FOC value of d is a set whose sole member is identical to the EP value of d, and the PROM value of d is $-$, or
   ii) the FOC value of d is an empty set and the PROM value of d is $+$.

(34) Suppose that a sign whose order domain is $\langle d_1,\ldots,d_n\rangle$ has undergone total compaction to produce a new domain object d_0, that the FOC value of d_i ($0 \le i \le n$) is F_i (when defined), that the PROM value of d_i ($0 \le i \le n$) is P_i (when defined), and that the EP value of d_0 is M.

a. If $P_1 = \cdots = P_n = -$, then $F_0 = F_1 \cup \cdots \cup F_n$ and $P_0 = -$.
b. If $n = 2$, d_1 is a d-argument of d_2, $P_1 = +$, and $P_2 = -$, then either
   i) $F_0 = F_1 \cup F_2 \cup \{M\}$ and $P_0 = -$, or
   ii) $F_0 = F_1 \cup F_2$ and $P_0 = +$.
c. Otherwise, the FOC value and the PROM value of d_0 are undefined (and the given structure is therefore ill-formed).

(35) A domain object X is a *d-argument* of another domain object Y if and only if

a. The SYNSEM|CAT|HEAD value of X is token-identical to the CAT|HEAD value of a member of a VALENCE list (either the COMPS list or the SUBJ list) of Y, and
b. the PHON value of Y does not contain more than one prosodic word.

The following is the definition of the phrase *within the scope of*, used in (28b).

(36) A focus X, which is a non-empty list of elementary predications $\langle x_1,\ldots,x_n\rangle$ ($n \ge 1$), is *within the scope of* a focus-sensitive operator Y if and only if for each i ($1 \le i \le n$), the HNDL value of x_i is identical to or outscoped by the SCOPE value of Y.

The following is the second of the two constraints on the kinds of alternatives that a focus can be contrasted with. (The first one is stated in (31).)

(37) Suppose that a focus X, which is a non-empty list of elementary predications, is to be interpreted as contrasting with another non-empty list of elementary predications, Y. Then none of the HNDL values of the elementary predications inside Y can be a handle h such that (i) h is not the HNDL value of any of the elementary predications in X and (ii) h is the HNDL value of an elementary predication outside X.

[9] What is stated in (34) can, and probably should, be incorporated into the definition of the total compaction operation.

References

Artstein, Ron. 2004. Focus Below the Word Level. *Natural Language Semantics* 12(1), 1–22.

Copestake, Ann, Flickinger, Dan, Sag, Ivan A. and Pollard, Carl. 1999. Minimal Recursion Semantics: An Introduction. Ms., Stanford University.

Kathol, Andreas. 1995. *Linearization-Based German Syntax*. Ph. D.thesis, Ohio State University, Columbus.

Kathol, Andreas and Pollard, Carl. 1995. Extraposition via Complex Domain Formation. In *33rd Annual Meeting of the Association for Computational Linguistics*, pages 174–180, San Francisco: Morgan Kaufmann.

Krifka, Manfred. 1991. A Compositional Semantics for Multiple Focus Constructions. In Steven Moore and Adam Zachary Wyner (eds.), *Proceedings of the First Semantics and Linguistic Theory Conference*, pages 127–158, Ithaca: Cornell Working Papers in Linguistics.

Krifka, Manfred. in press. The Semantics of Questions and the Focusation of Answers. In Chungmin Lee, Matthew Gordon and Daniel Büring (eds.), *Topic and Focus: A Cross-Linguistic Perspective on Intonation and Meaning*, pages 139–151, Dordrecht: Kluwer Academic Publishers.

Krifka, Manfred. to appear. Association with Focus Phrases. In Valerie Molnar and Susanne Winkler (eds.), *Architecture of Focus*, Berlin: Mouton de Gruyter.

Kubozono, Haruo. 1993. *The Organization of Japanese Prosody*. Tokyo: Kurosio.

Pierrehumbert, Janet and Beckman, Mary. 1988. *Japanese Tone Structure*. Cambridge, Mass.: MIT Press.

Pulman, Stephen G. 1997. Higher Order Unification and the Interpretation of Focus. *Linguistics and Philosophy* 20, 73–115.

Rooth, Mats. 1992. A Theory of Focus Interpretation. *Natural Language Semantics* 1, 75–116.

Sag, Ivan A., Wasow, Thomas and Bender, Emily M. 2003. *Syntactic Theory: A Formal Introduction*. Stanford: CSLI, second edition.

Schwarzschild, Roger. 1999. Givenness, AvoidF and Other Constraints on the Placement of Accent. *Natural Language Semantics* 7, 141–177.

Steedman, Mark. 2000. *The Syntactic Process*. Cambridge, Mass.: MIT Press.

Yatabe, Shûichi. 1999. Particle Ellipsis and Focus Projection in Japanese. In *Language, Information, Text*, volume 6, pages 79–104, Department of Language and Information Sciences, University of Tokyo.

Yatabe, Shûichi. 2001. The Syntax and Semantics of Left-Node Raising in Japanese. In Dan Flickinger and Andreas Kathol (eds.), *Proceedings of the 7th International Conference on Head-Driven Phrase Structure Grammar*, pages 325–344, Stanford: CSLI, http://cslipublications.stanford.edu/HPSG/.

Yatabe, Shûichi. 2003. A Linearization-Based Theory of Summative Agreement in Peripheral-Node Raising Constructions. In Jong-Bok Kim and Stephen Wechsler (eds.), *Proceedings of the 9th International Conference on Head-Driven Phrase Structure Grammar*, pages 325–344, Stanford: CSLI, http://cslipublications.stanford.edu/HPSG/.

Against opacity

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Abstract

Compositionality often presupposes a notion of *opacity* in that the combination of the meanings M_1 and M_2 of the subconstituents of a constituent C into the meaning of C must be blind to the inner structure of M_1 and M_2. I will show that the more relaxed notion of compositionality advocated by Egg (2004), which allows a syntactic constituent to refer to only a *part* of its sister constituent extends straightforwardly to highly problematic challenges for semantic composition like *John's former car*: One can derive its semantics from a surface-oriented syntactic structure even though the meanings of its syntactic subconstituents are *intertwined* in the meaning of the whole expression.

1 Introduction

Although the so-called Frege principle of compositionality merely states that the meaning of a whole is determined exclusively by the meanings of its parts plus the way in which these are put together, the principle is very often implemented in a much more restricted way: Then the semantic contribution of a constituent is the result of functional application of the meaning of one subconstituent (the *functor*) to the meaning of the other one (the *argument*). The inner structure of the meaning of either subconstituent is *opaque* to this application. Constituents contributing functors ('semantic heads') are distinguished syntactically as syntactic heads, except in adjunction structures, here the adjunct provides the functor.

For many expressions, however, this strict 1:1 relation between syntax and semantics cannot be postulated on the basis of their visible syntactic structure. I.e., there are mismatches between syntax and semantics; examples for such mismatches include a multitude of cases in which a constituent C_1 may pertain semantically to only *part* of its syntactic sister C_2.

E.g., in the preferred interpretation of (1) as 'person who dances beautifully', the adjective pertains to the verb stem only. In a similar fashion, the adverbial in (2) pertains only to that part of the verb semantics that specifies the *aftermath* of the change of state described by the verb. The resulting reading is 'go away and be absent for two hours'.[1]

(1) beautiful dancer

(2) leave for two hours

To bridge the gap between (visible) syntactic structure and semantics for examples as (1) and (2), generative approaches as Larson (1998) and von Stechow (1996) assign them a not directly visible but semantically relevant syntactic layer. The 1:1 relation is then postulated between this second syntactic layer and semantics.

[1] Formally, the aftermath-specifying part of the verb semantics can be formalised as the argument of a change-of-state operator like BECOME in a decomposition analysis of the verb semantics (Dowty, 1979).

However, this strategy is not open to advocates of more surface-oriented syntactic analyses. To bridge gaps between syntax and semantics within such a syntactic analysis, Egg (2004, to appear) suggests interfaces for cases as (1)-(2) that allow semantic reference of a semantic head to only part of its syntactic sister constituent. I.e., semantic compositionality is relaxed in that the argument is no longer semantically opaque in every case. The structure of the resulting semantic representation is depicted schematically by (3), where the 'arg_n' are argument parts:

(3) $\text{arg}_1(\text{functor}(\text{arg}_2))$

However, there are even more complex data, where opacity must be given up for *both* functor and argument, in particular, expressions like (4):

(4) John's former car

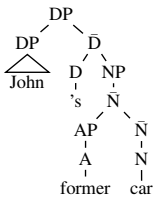
Larson and Cho (2003) point out that the possessive relation involved in the genitive may be in the scope of the scopal adjective *former* or not, which gives rise to ambiguity. The two resulting readings can be glossed as '(set of properties of) the only x that used to be a car in the possession of John' and '(set of properties of) the only x in the possession of John that used to be a car'.

Semantic representations for these readings are given in (5). Here 'POSS' glosses the possession relation, '$\iota x.P(x)$' refers to the only individual in the extension of P (this uniqueness is introduced as presupposition); $\mathbf{former}'$ is a relation between an intension of a predicate and an individual x that is true at a given world-time pair $\langle w,t\rangle$ iff the extension of the predicate at $\langle w,t\rangle$ does not hold for x but holds for x for a $\langle w,t'\rangle$, where $t' < t$:

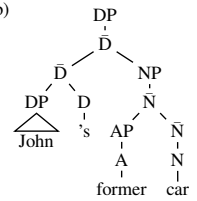
(5) (a) $\lambda P.P(\iota x.\mathbf{former}'(^\wedge\mathbf{car}'(x) \wedge \text{POSS}(\mathbf{john}', x)))$
(b) $\lambda P.P(\iota x.\mathbf{former}'(^\wedge\mathbf{car}'(x)) \wedge \text{POSS}(\mathbf{john}', x))$

In a surface-oriented syntactic analysis, (4) is assigned a structure like the ones in (6). Here and in the following, bar nodes in nonbranching tree parts have been omitted. The *'s* element of the so-called Anglo-Saxon genitive is analysed not as a nominal affix but as an (enclitic) constituent that attaches to whole DPs. These DPs (as *John* in *John's*) can either be regarded as specifiers (6a) or as complements of the *'s* element (6b):

(6) (a)



(b)



But, regardless of which alternative in (6) is chosen, the syntax-semantics interface faces a severe problem in the construction of the semantic representation (5a) from the chosen underlying syntactic structure: The semantic contribution of the *'s* element and its NP complement are *interleaved*, because this element contributes semantically both the iota operator and the possessive relation. This constellation is depicted in (7), a schematisation of (5a):

(7) $\text{Det}_1(\text{NP}_1(\text{Det}_2(\text{NP}_2)))$

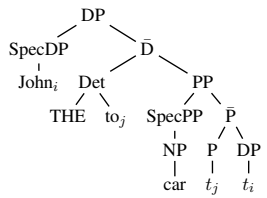
Here 'Det_2' is the part of the determiner semantics that introduces the possessive relation, 'Det_1', the one that introduces the iota operator. Similarly, 'NP_1' refers to the part of the NP semantics that is contributed by the adjective *former*, 'NP_2', to the rest of the NP semantics (here, the meaning of *car*).

I.e., neither the semantic head nor its sister constituent are semantically opaque anymore. In this paper, I will show that the approach to compositionality adopted in Egg (2004, to appear) for structures as (3) can be extended to handle the more involved structure (7) as instantiated by (5a). But before this extension is laid out in detail, I will first review Larson and Cho's account of examples like (4).

2 Larson and Cho's analysis

In order to get the scope of *former* over the possessive relation right, Larson and Cho (2003) assume the following structure for *John's car*:

(8)



The syntactic structure of the genitive is described as a PP ('*car to John*') whose head is the possession-indicating *to*. This PP is the complement of an abstract

definite determiner THE. The complement of the preposition moves to SpecDP and the preposition incorporates into the determiner. The resulting Det element spells out as '*s*' and cliticizes to the DP *John*.

The ambiguity in *John's former car* can then directly be put down to different possibilities of adjoining the adjective (phrase): The surface structure does not tell whether the adjective is adjoined to *car* only (which functions as specifier of the PP) or to the whole PP that comprises the possessive relation.

But there are even more complicated examples (Larson and Cho, 2003):

(9) John's old new car

There are three scope bearing items below the iota operator in (9), viz., the adjectives and the possessive relation. If one assumes that the word order of the adjectives determines their scope, there are still three theoretical scoping possibilities: The possessive relation might have scope above, between, or below the adjectives. The corresponding readings are:[2]

(10) (a) 'the car that belongs to John and is quite old for a new car'
($\text{POSS} < \textit{old} < \textit{new}$)

(b) 'the car that is quite old for a new car belonging to John'
($\textit{old} < \text{POSS} < \textit{new}$)

(c) 'the car that is quite old for a recent acquisition of John'
($\textit{old} < \textit{new} < \text{POSS}$)

Larson and Cho (2003) accept only the second of these readings for (9). But, considering the fact that the simpler (11) is acceptable (in the interpretation 'the car which is comparatively old for a new car'), I believe that the first reading is possible, too.

(11) the old new car

This reading can be based on appropriate semantic analyses of *old* and *new*, e.g., (12):

(12) $\mathbf{old}'/\mathbf{new}'$ holds between properties (sets of entities) P and individuals x iff $P(x)$ and the lifespan of x extends further/less further back than the average lifespan of the elements of P

Accepting the third reading (10c) too, is more in line with Larson and Cho (2003)'s analysis than their own judgement: The surface order of the adjectives is compatible with both of them adjoining to the PP or to the noun, or with the first one adjoining to the PP, and the second, to the noun. This follows directly from their

[2] '$<$' is an abbreviation for the relation 'has scope over'.

analysis: if the first adjective adjoins to the NP *car* it is impossible for the second one to adjoin to a higher node, in particular, the PP node. In contrast, their analysis could not block a reading in which either adjective adjoins to the PP.

Thus, this analysis predicts that it is impossible for only the second adjective to have scope over POSS. This follows from the assumption that *old* c-commands *new* in the syntax, which is incompatible with assuming that *new* has semantic scope over *old*.

In the following I will model these semantic intuitions in a syntax-semantics interface that builds on the analyses in Egg (2004, to appear).

3 The semantic representation formalism

This section sketches the underlying semantic representation formalism *Constraint Language for Lambda Structures* (CLLS; Egg et al. 2001), on which the analyses in this paper are based. CLLS is an *underspecification formalism*, i.e., it captures structural ambiguities in *descriptions* or *constraints* that describe whole sets of semantic representations, one for each reading of a structurally ambiguous expression. In this paper, I will use an abbreviated form of CLLS, which facilitates reading considerably. In a second subsection I will sketch the stand of CLLS (and other underspecification formalisms) on the question of how to define compositionality taking into account the fact that the 1:1 relation between syntactic structures and meanings cannot be upheld for cases of structural ambiguities like (4).

3.1 The Constraint Language for Lambda Structures

CLLS expressions describe fully specified semantic representations, here, λ-terms. Those λ-terms that are compatible with a constraint are called its *solutions*. If one is only concerned with solutions that comprise only material explicitly mentioned in the constraint, constraints emerge as a *partial orders* on sets of fragments of semantic representations.

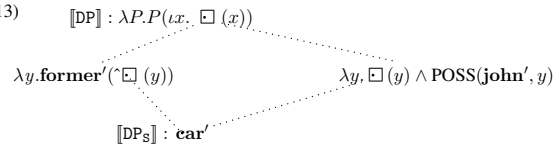
Consider e.g. the CLLS constraint (13) for the meaning of (4). It illustrates the ingredients of simplified CLLS expressions:[3]

- *fragments* of λ-terms
- not yet known parts of these fragments, indicated by '*holes*' ($\boxdot$)
- *dominance relations* (depicted by dotted lines) that relate fragments to holes

Dominance relations between a fragment and a hole express that the fragment is an (im-) proper part of what the hole stands for. These dominance relations model scope, and are therefore also used to model quantifier scope ambiguities.

[3] Please ignore at the moment any labels like '$[\![\mathtt{C}]\!]$', they will be explained in section 4.

(13)



In this constraint, the semantic contribution of the genitive DP is spread over the top fragment (which introduces the iota operator) and the right fragment, where the possessive relation is located. The left and the bottom fragments model the adjective and the noun semantics, respectively.

The fact that there is a hole in the top fragment in (13) indicates that the λ-term described by the constraint cannot yet be fully specified, we only know that it describes the properties of an ι-expression of some sort. However, the dominance relations between this hole and the fragments on the right and the left indicate that these fragments are the immediate parts of this ι-expression. The noun semantics in the bottom fragment is dominated by holes in the right and left fragments, thus, ends up in the scope of both the adjective and the possessive relation. Structures like (13) are called *dominance diamonds*.

To derive fully specified λ-terms from constraints, information is added monotonically, in particular, by strengthening dominance relations between holes and fragments to *identity*. For (13), there are two choices. The bottom fragment can be identified with the hole in the possessive fragment, the possessive fragment, with the hole in the adjective fragment, and, the adjective fragment, with the hole in the top fragment. This returns (5a); here the possessive relation is in the scope of the adjective. If the procedure is started by identifying the bottom fragment with the hole in the adjective fragment, the eventual result is (5b). There are no other solutions, thus, (13) is an adequate representation of the semantics of (4).

3.2 Compositionality for cases of structural ambiguity

The proposed approach to structural ambiguity raises the question of what its underlying notion of compositionality is. The basic problem is that there is no 1:1 relation between syntactic structures and semantic interpretations for cases of structural ambiguities like (4); other prominent examples of such ambiguities are the well-known scope ambiguities like (14), where the scope relations between quantifying expressions (here, the NPs) are still open. In all these cases, one syntactic structure seems to correspond to several semantic structures.

(14) Every woman loves a man

But this one-many correspondence would be in conflict with the *functional* nature of semantic interpretation, which associates one specific syntactic structure with only one single semantic structure (see Westerståhl 1998; Hodges 2001 for details).

The problem has been tackled from several angles. To preserve a 1:1 relation between syntactic and semantic structure, approaches within Generative Syntax assume that each reading corresponds to a unique syntactic structure on a not directly visible but semantically relevant syntactic level (as laid out in section 2 for (14)). At this level, structural ambiguities are resolved. Most prominent here is the theory of *Logical Form* May (1985), which e.g. determines quantifier scope by raising them to a position that unambiguously fixes their scope.

In contrast, Cooper (1983) explicitly introduces nondeterminism in the mapping from syntax to semantics: Roughly, quantifying NPs have - apart from their standard interpretation - another, structured interpretation, which sets aside their semantic contribution in a special storage mechanism ('Cooper storage'). The semantic representation for any constituent C is thus structured into a tuple. The one element of the tuple is a (possibly empty) storage that lists the semantic contribution of quantifying NPs within C, its other element is the rest of the semantics of C. The storage list is then inherited up the syntactic tree; its elements can be combined with the main semantics of any constituent the NP is part of as long as this main semantics is of type t.

The underspecification approach pursued in this paper contrasts with these two approaches in that it sticks to the 1:1 relation between syntactic and semantic structure by relating one syntactic structure to one underspecified semantic structure (not to specific readings of this syntactic structure). In addition, it is also the goal of this approach to build the semantic analyses on comparatively surface-oriented syntactic structures.

It is then the goal of of the syntax-semantics interface to bridge the gap between syntax and semantics in the case of structural ambiguity. With the help of an underspecification formalism one can define very flexible syntax-semantics interfaces; this will be expounded in the next section.

4 The interface rules

This section describes the syntax-semantics interface that serves for the derivation of constraints like (13) from a surface-oriented syntactic analysis.[4] This interface presumes that the constraint for the semantic contribution of every syntactic constituent distinguishes a *main* and an *embedded* fragment. CLLS constraints like (13), indicate the main fragment of a constituent C by '$[\![\mathtt{C}]\!]$' and its secondary fragment, by '$[\![\mathtt{C_S}]\!]$'. '$[\![\mathtt{C}]\!]:\mathtt{F}$' means that the main fragment of C is defined as fragment F. As an example, consider the constraint for the semantics of the *'s* element, where the possessive relation shows up in the secondary fragment, while the iota operator is located in the main fragment. The argument of the determiner semantics (i.e., the semantics of the NP argument of the determiner, abstracted over by λQ) ends up in a third fragment of its own:

[4] In the following, I will base the semantic construction of (4) on the syntactic structure (6a).

(15) $[\![\mathtt{D}]\!] : \lambda Q \lambda \mathscr{P} \lambda P. \mathscr{P}(\lambda z. P(\iota x. \boxdot(x)))$

Q $\quad [\![\mathtt{D_S}]\!] : \lambda P \lambda y. P(y) \wedge \mathbf{POSS}(z, y)$

The idea behind this semantic representation is that the property with respect to which uniqueness is presupposed by the iota operator is not yet completely determined. Even though we know that it consists of the semantics of the determiner's NP complement and the possessive relation, the semantics of the determiner cannot (and should not) predetermine the interaction between the two. Therefore, either one gets its own fragment, but is dominated by a common hole. (The abstraction over $\mathscr{P}$ integrates the semantic contribution of the specifier of the *'s* constituent.)

Interface rules specify for each non-lexical constituent C how the constraints Con_1 and Con_2 of its immediate constituents, which are inherited by C, are combined into a new constraint for C. The rules combine Con_1 and Con_2 by addressing their main and secondary fragments and determine these features for C. For instance, the simple rule that non-branching $\bar{\mathtt{X}}$ constituents inherit their fragments from their heads is written as (16):

(16) $[_{\bar{\mathtt{X}}}\ \mathtt{X}] \overset{\text{(SSI)}}{\Rightarrow}$

$[\![\bar{\mathtt{X}}]\!] : [\![\mathtt{X}]\!]; \quad [\![\bar{\mathtt{X}}_\mathtt{S}]\!] : [\![\mathtt{X}_\mathtt{S}]\!]$

The semantic representation of modification (adjunction) structures[5] is determined by the interface rule (17). The main fragment of the whole constituent ($[\![\bar{\mathtt{X}}_1]\!]$) is equal to $[\![\bar{\mathtt{X}}_2]\!]$, the one of the modified expression. But its secondary fragment $[\![\bar{\mathtt{X}}_{1\mathtt{S}}]\!]$ is not inherited from this expression, it consists of an application of the modifier fragment $[\![\mathtt{Mod}]\!]$ to a hole that dominates the secondary fragment $[\![\bar{\mathtt{X}}_{2\mathtt{S}}]\!]$ of the modified expression. The modifier fragments are equated ($[\![\mathtt{Mod}]\!]$: $[\![\mathtt{Mod_S}]\!]$) to facilitate reading.

(17) $[_{\bar{\mathtt{X}}_1}\mathtt{Mod}\ \bar{\mathtt{X}}_2] \overset{\text{(SSI)}}{\Rightarrow}$

$[\![\bar{\mathtt{X}}_{1\mathtt{S}}]\!] : [\![\mathtt{Mod}]\!](\ \boxdot\ ) \quad [\![\mathtt{Mod}]\!]: [\![\mathtt{Mod_S}]\!] \quad [\![\bar{\mathtt{X}}_1]\!]:[\![\bar{\mathtt{X}}_2]\!]$

$[\![\bar{\mathtt{X}}_{2\mathtt{S}}]\!]$

Finally, the interface links the syntax rule `XP -> X̄` to a semantic rule that introduces a hole as the main fragment of the XP. Since this hole dominates both fragments of the $\bar{\mathtt{X}}$ constituent, the effect of this rule is often the construction of the upper half of the dominance diamond:

[5] Syntactically, adjunction of XP to a constituent C means that XP and C are the daughters of a node in the syntax tree that is of the same category as C.

(18) $[_{\texttt{XP}}\ \bar{\texttt{X}}]$ $\overset{\text{(SSI)}}{\Rightarrow}$

$[\![\texttt{XP}]\!] : \boxdot$

$[\![\bar{\texttt{X}}\texttt{P}_\texttt{S}]\!]$:$[\![\bar{\texttt{X}}]\!]$ $[\![\bar{\texttt{X}}_\texttt{S}]\!]$

5 Application

The semantic representations for the constituents of (4) are (15) for the *'s* constituent and (19a-c) for the adjective, the noun, and the proper name.

(19) (a) $[\![\texttt{A}]\!]$, $[\![\texttt{A}_\texttt{S}]\!]$: $\lambda P\lambda x.\mathbf{former}'(\hat{}P(x))$
(b) $[\![\texttt{N}]\!]$, $[\![\texttt{N}_\texttt{S}]\!]$: $\mathbf{car}'$
(c) $[\![\texttt{DP}]\!]$, $[\![\texttt{DP}_\texttt{S}]\!]$: $\lambda P.P(\mathbf{john}')$

First, the bar projections of A and N inherit their semantic representations from their sole, lexical daughter node by (16). With rule (18), the semantic representation of the AP *former* emerges as (20). Then rule (17) combines (20) with the semantics of *car* to derive (21), the semantics of *former car* as $\bar{\text{N}}$. Here the secondary fragment dominates the main one, which is due to the identity of main and secondary fragment for the noun *car*.

(20) $[\![\texttt{AP}]\!] : \boxdot$

$[\![\texttt{AP}_\texttt{S}]\!] : \lambda P\lambda x.\mathbf{former}'(\hat{}P(x))$

(21) $[\![\bar{\texttt{N}}_\texttt{S}]\!] : \lambda x.\mathbf{former}'(\hat{}\ \boxdot\ (x))$

$[\![\bar{\texttt{N}}]\!] : \mathbf{car}'$

According to rule (18), *former car* as NP is then assigned the semantic constraint in (22):

(22) $[\![\texttt{NP}]\!] : \boxdot$

$\lambda x.\mathbf{former}'(\hat{}\ \boxdot\ (x))$

$[\![\texttt{NP}_\texttt{S}]\!] : \mathbf{car}'$

The decisive rule for the construction of the desired diamond structure is now (23). This rule is taken from Egg (to appear) where it is used for the semantic construction for Turkish DPs. But, since we are dealing with a determiner here whose semantics distinguishes both a main and a secondary fragment, the condition is added that the secondary fragment of the determiner is applied to a hole that dominates the NP's secondary fragment.[6]

[6]This addition is compatible with the analyses in Egg (to appear) for Turkish determiners like *bir* 'a' or *her* 'every', because for them it is assumed that their main and secondary fragments are identical.

(23) $[_{\bar{\texttt{D}}}\ \texttt{D}\ \texttt{NP}]$ $\overset{\text{(SSI)}}{\Rightarrow}$

$[\![\bar{\texttt{D}}]\!]$: $[\![\texttt{D}]\!]([\![\texttt{NP}]\!])$; $[\![\texttt{D}_\texttt{S}]\!](\boxdot)$

$[\![\bar{\texttt{D}}_\texttt{S}]\!] : [\![\texttt{NP}_\texttt{S}]\!]$

The result of applying (23) to (22) and (15) is then the dominance diamond (24):

(24) $[\![\bar{\texttt{D}}]\!] : \lambda\mathscr{P}\lambda P.\mathscr{P}(\lambda z.P(\iota x.\ \boxdot\ (x)))$

$\square$ $\lambda y.\ \boxdot\ (y) \wedge \text{POSS}(z, y)$

$\lambda y.\ \mathbf{former}'(\hat{}\boxdot(y))$

$[\![\bar{\texttt{D}}_\texttt{S}]\!] : \mathbf{car}'$

The last step is then the integration of the specifier semantics (19c) by rule (25):

(25) $[_{\texttt{XP}}\ \texttt{SpecXP}\ \bar{\texttt{X}}]$ $\overset{\text{(SSI)}}{\Rightarrow}$

$[\![\texttt{XP}]\!] : [\![\bar{\texttt{X}}]\!]([\![\texttt{SpecXP}]\!])$; $[\![\texttt{XP}_\texttt{S}]\!]$:$[\![\bar{\texttt{X}}_\texttt{S}]\!]$

Omitting the additional irrelevant empty hole on the left branch, the result of applying (25) to (19c) and (24) is then exactly the constraint (13), as desired.
The last part of this section deals with example (9), whose semantic representation in the proposed analysis is (26). The crucial difference to (24) is the twofold application of rule (17):

(26) $[\![\texttt{DP}]\!] : \lambda P.P(\iota x.\ \boxdot\ (x))$

$\square$ $\lambda y.\ \boxdot\ (y) \wedge \text{POSS}(\mathbf{john}', y)$

$\lambda y.\mathbf{old}'(\boxdot)(y)$

$\lambda y.\ \mathbf{new}'(\boxdot)(y)$

$[\![\texttt{DP}_\texttt{S}]\!] : \mathbf{car}'$

This constraint has exactly three solutions:

(27) (a) $\lambda P.P(\iota x.\mathbf{old}'(\lambda y.\mathbf{new}'(\mathbf{car}')(y))(x) \wedge \text{POSS}(\mathbf{john}', x))$
(b) $\lambda P.P(\iota x.\mathbf{old}'(\lambda y.\mathbf{new}'(\mathbf{car}')(y) \wedge \text{POSS}(\mathbf{john}', y))(x))$
(c) $\lambda P.P(\iota x.\mathbf{old}'(\lambda y.\mathbf{new}'(\lambda z.\mathbf{car}'(z) \wedge \text{POSS}(\mathbf{john}', z))(y))(x))$

But these three readings correspond exactly to the three interpretations of (9) as listed in (10). This result is achieved because the scope of the adjectives is fixed in (26), but the scope of the possessive relation is not. Consequently, it can take scope above, between, or below the adjective.

6 Conclusion

In this paper, I have shown an extension of the approach of Egg (2004) to the case of *John's former car*, where opacity could not be opheld because the meanings of its immediate syntactic constituents are intertwined in the meaning of the expression as a whole. This corraborates the vision of Egg (2004) that the approach might also be applied successfully to non-Indo-European languages like Turkish, where opacity is much less common than in languages like English.

References

Cooper, Robin. 1983. *Quantification and syntactic theory*. Dordrecht: Reidel.

Dowty, David. 1979. *Word meaning and Montague grammar*. Dordrecht: Reidel.

Egg, Markus. 2004. Mismatches at the syntax-semantics interface. In Stefan Müller (ed.), *Proceedings of the 11th International Conference on Head-Driven Phrase Structure Grammar*, pages 119–139, Stanford: CSLI Publications.

Egg, Markus. to appear. Anti-Ikonizität an der Syntax-Semantik-Schnittstelle. *Zeitschrift für Sprachwissenschaft* Available from `http://www.let.rug.nl/~egg/Papiere/gk_revidiert.ps.gz`.

Egg, Markus, Koller, Alexander and Niehren, Joachim. 2001. The constraint language for lambda-structures. *Journal of Logic, Language, and Information* 10, 457–485.

Hodges, Wilfrid. 2001. Formal features of compositionality. *Journal of Logic, Language, and Information* 10, 7–28.

Larson, Richard. 1998. Events and modification in nominals. In Devon Strolovitch and Aaron Lawson (eds.), *Proceedings from SALT VIII*, pages 145–168, Cornell University, Ithaca.

Larson, Richard and Cho, Sungeun. 2003. Temporal adjectives and the structure of possessive DPs. *Natural Language Semantics* 11, 217–247.

May, Robert. 1985. *Logical Form. Its structure and derivation*. Cambridge: MIT Press.

von Stechow, Arnim. 1996. The different readings of 'Wieder': A structural account. *Journal of Semantics* 13, 87–138.

Westerståhl, Dag. 1998. On mathematical proofs of the vacuity of compositionality. *Linguistics & Philosophy* 21, 635–643.

German Integrated Verb Second Clauses,
Relative Clauses, and Information Structure

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Abstract

In this paper we present data of German integrated verb second clauses and verb final relative clauses, which at first sight seem problematic for a compositional analysis. However, we show that the compositional analysis of restrictive relative clauses in (Janssen, 1982) can be adapted, but cannot be sustained due to overgeneration and must be considered unintuitive in light of the paratactic syntactic analysis for the verb second clauses from Gärtner (2001). Hence we present a conceptually simpler analysis along the lines of Endriss and Gärtner (to appear), which makes use of information structural properties of the involved clauses. We conclude with a brief discussion on the compositional status of such an approach.

1 Introduction

German provides for a special brand of verb second clauses, which can replace standard verb final relative clauses in certain contexts. This is illustrated in the following examples[1] (a), where (/) indicates a non-final marking of the boundary (e.g. a high boundary tone or continuation rise). Thus the second clause appears *integrated* into the first clause w.r.t. intonation. In Gärtner (2001), these instances are therefore referred to as *integrated verb second clauses* (IV2). The examples in (b) show the corresponding versions, where the second clause functions as a restrictive relative clause. In (c) IV2 are constrasted with independent V2 declarative sentences. Here both sentences constitute distinct intonational units, indicated by (\), a final boundary marking (e.g. falling tone, drop, pause, etc.).

(1) a. Das Blatt hat eine Seite, (/) die ist ganz schwarz.
The sheet has one side that is completely black.

b. Das Blatt hat eine Seite, (/) die ganz schwarz ist.
The sheet has one side that completely black is.
'The sheet has one side that is completely black.'

c. # Das Blatt hat eine Seite. (\) Die ist ganz schwarz.
The sheet has one side. It is completely black.
'The sheet has one side. It is completely black.'

(2) a. Apfeldorf hat viele Häuser, (/) die stehen leer.
Apfeldorf has many houses that stand empty.

b. Apfeldorf hat viele Häuser, (/) die leer stehen.
Apfeldorf has many houses that empty stand.
'Apfeldorf has many houses that are vacant.'

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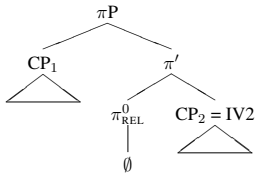
[1]The examples are taken from Gärtner (2001).

c. Apfeldorf hat viele Häuser. (\) Die stehen leer.
Apfeldorf has many houses. They stand empty.
'Apfeldorf has many houses. They are vacant.'

Concerning the syntax, Gärtner (2001) argues that IV2 have to be treated paratactically as follows (where π stands for *paratactical*).

(3)



This is evidenced by, among other things, the facts that IV2 must occur extraposed, i.e. at the right edge of CP_1 and that the pronoun is not a relative pronoun but a weak demonstrative (see (Gärtner, 2001) for an elaborate discussion).

Semantically, in fact, the IV2 in (a) show a similar behaviour as the restrictive relative clause counterparts in (b) concerning interpretation. For instance, (1a) and (1b) both say that the sheet has one completeley black page. This is in contrast with the sequence of V2 declarative clauses in (1c), where the pragmatically odd meaning is conveyed that the sheet has only one page and that this page is black. This effect is due to a Horn-scale implicature which arises after having processed the first sentence. The fact that this implicature does not arise in the case of (1a) provides another argument for the non-autonomy of IV2. Though syntactically (1a) and (1c) are both analysed as S-S constructions, in case of IV2 the initial sentence is not computed in isolation and no implicature is triggered. Likewise, (2a,b) state that there are many vacant houses in Apfeldorf. Again this is different from the (c) variant, which makes the statement that Apfeldorf overall has many houses. At first sight, from the semantic point of view, it seems that an analysis of the IV2 phenomena should yield a restrictive interpretation of the clause w.r.t. to the DP it seems attached to. Such a relative clause analysis was proposed by Gärtner (2001) and Brandt (1990).

Let us in the following explore the possible readings of (2) in closer detail. According to Partee (1988), *many* is ambiguous between a proportional and a cardinal reading.

$$\begin{array}{lrcll} \text{cardinal :} & \mathsf{many}_{\text{card}}(A)(B) & \equiv & |A \cap B| \geq n; & n \text{ a contextual number} \\ \text{proportional :} & \mathsf{many}_{\text{prop}}(A)(B) & \equiv & \frac{|A \cap B|}{|A|} \geq k; & k \text{ a contextual percentage} \end{array} \tag{4}$$

In a proportional reading of (2a), an interpretation of the second clause as restrictive w.r.t. the noun *Häuser* would result in the statement that many vacant houses are

such that they are in Apfeldorf[2]:

$$\mathsf{many}_{\text{prop}}[x,\ (\mathsf{house}(x) \wedge \mathsf{vacant}(x)),\ \mathsf{have}(\mathsf{apfeldorf}, x)] \tag{5}$$

However, as a closer look reveals, the restrictive relative clause construal does not give the correct results. (5) is clearly not what (2a) and (2b) mean. They rather say that many of the houses in Apfeldorf are such that they are vacant. So the interpretation we are actually looking for is the following.

$$\mathsf{many}_{\text{prop}}[x,\ (\mathsf{house}(x) \wedge \mathsf{have}(\mathsf{apfeldorf}, x)),\ \mathsf{vacant}(x)] \tag{6}$$

This seems to suggest the following generalization:

(7) *many* incorporates the entire remaining matrix clause information into its restrictor, while the information of the second clause constitutes its nuclear scope.

So the restrictive relative clause analyses of Gärtner (2001) and Brandt (1990) seem to be on the wrong track (for the proportional reading).

Due to the ambiguity of *many*, one would also expect that there is a cardinal reading with IV2s. This prediction is confirmed by the following data where *many* can be interpreted as cardinal:

(8) Es gibt viele Häuser, (/) die stehen leer.
It gives many houses that stand empty.

Sentence (8) in its preferred reading states that the number of empty houses is (surprisingly) high. It does not necessarily mean that among the contextually relevant houses there are many empty ones. This shows that also with IV2, the cardinal reading is still available[3]. However, with the cardinal reading of *many* the generalization from above cannot be tested. This is due to the fact that the restrictor and nucleus cannot be told apart due to the symmetry of $\mathsf{many}_{\text{card}}$.

For other quantifiers, the generalization in (7) is also easy to overlook, as the two different ways of determining the restrictor and nuclear scope yield equivalent interpretations. For instance, in the case of (1a) and (1b) the statement that there is a side of the sheet which is black is equivalent to the statement that there is a black side which the sheet has. Note that this is true for all quantifiers D which are conservative and symmetric as the following holds (cf. Barwise and Cooper (1981)).

$$D(A \cap B, C) \equiv D(A \cap C, B)$$

Because of this fact, we conclude that it only *seems* that IV2 and verb final clauses are interpreted as restrictive relative clauses as Gärtner (2001) and Brandt (1990)

[2] In the remainder of this text, we use a more appropriate notation $\mathsf{many}[x, A(x), B(x)]$ (which is equivalent to $\mathsf{many}(A)(B)$)

[3] Thanks to Sigrid Beck and Manfred Krifka for calling our attention to this.

claim. The actual analysis has to go along the lines of generalization (7) made above.

Complicating the picture even further, the generalization does not seem to hold for all quantifiers. Consider the following variants of (2) containing *die meisten (most)* instead of *viele (many)*.

(9) a. * Apfeldorf hat die meisten Häuser, (/) die stehen leer.
Apfeldorf has most houses that stand empty.

b. Apfeldorf hat die meisten Häuser, (/) die leer stehen.
Apfeldorf has most houses that empty stand.

'Most houses that are vacant are in Apfeldorf.'

As (9a) illustrates, the IV2 construction is illicit with a DP headed by *die meisten*. In fact, only a proper subclass of indefinites licenses the use of IV2s. With a verb final clause, (9b) actually has the restrictive RC interpretation that was unwarranted in the *viele* case. (9b) indeed states that Apfeldorf has the largest group of (contextually relevant) vacant houses.

At first sight, the paratactic analysis in (3) on the one side and the desired interpretation on the other side constitute an obvious problem for a compositional analysis. In the following section we will investigate to what extent the compositional treatment of relative clause constructions from Janssen (1982) can be adapted to yield the desired readings.

2 Relative Clauses and Compositionality

In (Janssen, 1982), Theo Janssen discusses the compositional interpretation of three options of RC attachment to its adjacent DP in English: attachment to the noun (the *CN-S analysis*), attachment to the DP (the *T-S analysis*[4], henceforth *DP-S analysis*), and attachment to the determiner (the *Det-S analysis*). Furthermore he investigates the more intricate case of RC constructions in Hittite from Bach and Cooper (1978), where the relative clause is a sentence that is adjoined left or right of the matrix sentence. With respect to the S-S attachment, Hittite resembles German IV2 sentences. Janssen proposes an *S-S analysis* of Hittite relative clauses that is based on his DP-S analysis of relative clauses for English. In the following we will illustrate the DP-S analysis of restrictive RCs and extend it to an S-S analysis that accounts for the German non-restrictive IV2 cases.

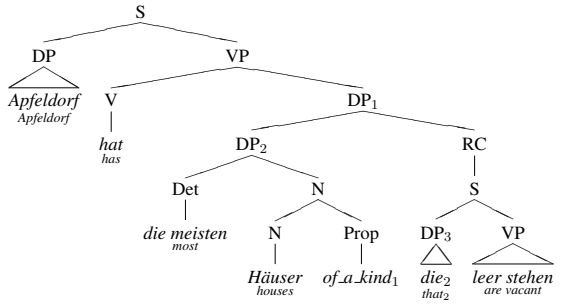
Consider example (9b), where the second clause is a (standard) verb final relative clause that has to be interpreted restrictively, as we argued above[5]. Janssen's

[4] where 'T' stands for 'term', the equivalent to DP in the Montagovian framework

[5] The exposition here is simplified and differs slightly from the one in Janssen, e.g. with respect to category names and the treatment of the relative clause without the Montagovian 'such that' construct.

DP-S analysis proceeds along the following structure.

(10)



Janssen derives the restrictive interpretation of the second clause by introduction of a syntactic variable *of_a_kind*$_1$ (translated as a set type variable P_1), which combines with the noun *Häuser* to $\lambda x[\mathsf{house}(x) \wedge P_1(x)]$. This serves as the restrictor of *most* which yields the DP interpretation

$$[\![\mathrm{DP}_2]\!] = \lambda Q[\mathsf{most}[x,\ (\mathsf{house}(x) \wedge P_1(x)),\ Q(x)]]. \tag{11}$$

The second clause is interpreted as the open proposition $\mathsf{vacant}(z_2)$ containing the free variable z_2, that corresponds to a syntactic variable *die*$_2$. At the RC node, an application of an indexed unary rule abstracts over this variable and transforms the open proposition into the property

$$[\![\mathrm{RC}]\!] = \lambda z_2 \mathsf{vacant}(z_2). \tag{12}$$

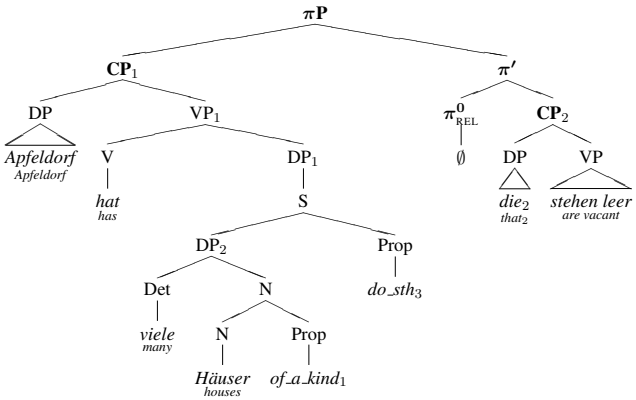
By application of another indexed rule at the DP$_1$ node, the RC can eventually be 'quantified in' the resulting DP.

$$[\![\mathrm{DP}_1]\!] = \lambda P_1[\![\mathrm{DP}_2]\!]([\![\mathrm{RC}]\!]) = \lambda Q[\mathsf{most}[x,\ (\mathsf{houses}(x) \wedge \mathsf{vacant}(x)),\ Q(x)]] \tag{13}$$

Completing the analysis of the sentence we get the correct restrictive interpretation

$$\mathsf{most}[x,\ (\mathsf{house}(x) \wedge \mathsf{vacant}(x)),\ \mathsf{have}(\mathsf{apfeldorf}, x)]. \tag{14}$$

This DP-S analysis with its approach to 'quantify in' later information can be extended to IV2s and the paratactic analysis in (3) by deferring the 'quantifying-in' of the CP$_2$ information until the analysis of CP$_1$ is completed. Furthermore, in order to account for the non-restrictive interpretation of (2a), we could propose an additional syntactic variable *do_sth*$_n$ (translated as a property variable Q_n) for the nuclear scope of the quantifier in the DP. Then the remaining matrix clause information and the CP$_2$ information can 'quantify in' the restrictor variable (corresponding to *of_a_kind*$_m$) and the nuclear scope variable (*do_sth*$_n$), respectively.



According to this construal, DP_1 is interpreted as

$$[\![\text{DP}_1]\!] \quad = \quad \lambda P_1 \mathsf{many}[x,\ (\mathsf{house}(x) \wedge P_1(x)),\ Q_3(x)] \tag{15}$$

abstracting over the restrictor variable P_1. Hence, the matrix verb *hat (has)* ends up in the restrictor of its object.

$$[\![\text{VP}_1]\!] \quad = \quad \lambda y \mathsf{many}[x,\ (\mathsf{house}(x) \wedge \mathsf{have}(y, x)),\ Q_3(x)] \tag{16}$$

The VP finally combines with the subject to yield the interpretation of the first clause. Eventually, 'quantifying in' of the π' (which now plays the role of RC in (10)) results in

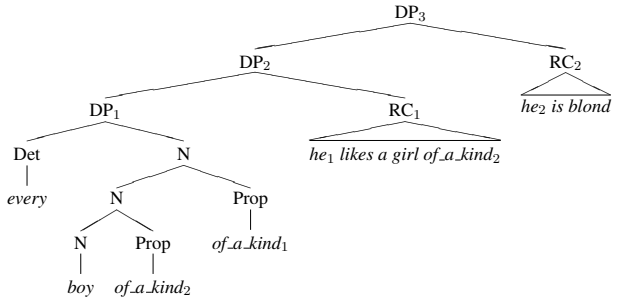
$$\lambda Q_3[\![\text{CP}_1]\!]([\![\pi']\!]) = \mathsf{many}[x,\ (\mathsf{house}(x) \wedge \mathsf{have}(\mathsf{apfeldorf}, x)),\ \mathsf{vacant}(x)] \tag{17}$$

which is the desired, non-restrictive reading for (2a). Although this is the correct meaning, this analysis suffers from certain problems.

The first problem with these examples is the fact that the correspondence between syntactic category and semantic type is not obeyed. In the IV2 case, the completed analysis of CP_1 would essentially result in a generalized quantifier despite its syntactic status of a clause. CP_1 could also occur as an isolated sentence and would then receive an entirely different interpretation of truth-value type. This mismatch is to be expected, because the underlying syntactic configuration does not reflect the semantic structure w.r.t. the semantic arguments of the quantifier. For instance, in simple sentences such as *Apfeldorf hat viele Häuser. ('Apfeldorf has many houses.')* the information about both the restrictor and the nuclear scope

of *many* is present in the clause and hence the information of the entire clause can be a proposition of truth-value type. This is different in the IV2 case (2a), where the information in the first clause only contributes to the restrictor, while the second clause contributes to the nuclear scope.

Second, and perhaps more importantly, such a 'quantifying in' analysis overgenerates[6]. For instance, in an analysis of the DP *every boy who likes a girl who is blond* (with stacked relative clauses for *boy*), the same syntactic variable *of_a_kind*$_2$ may occur once in the 'matrix' DP *every boy* and once in the embedded DP *a girl* as follows:



(18)

'Quantifying in' the RC_1 interpretation into the DP_1 using *of_a_kind*$_1$ results in

$$[\![DP_2]\!] = \lambda Q \forall y[(\mathsf{boy}(y) \wedge P_2(y) \wedge \exists x[\mathsf{girl}(x) \wedge P_2(x) \wedge \mathsf{like}(y, x)]) \rightarrow Q(y)]. \tag{19}$$

The final 'quantifying in' of the RC_2 results in

$$[\![DP_3]\!] = \lambda Q \forall y[(\mathsf{boy}(y) \wedge \mathsf{blond}(y) \wedge \exists x[\mathsf{girl}(x) \wedge \mathsf{blond}(x) \wedge \mathsf{like}(y, x)]) \rightarrow Q(y)] \tag{20}$$

resulting in the unavailable interpretation *every blond boy who likes every blond girl*. The operation of 'quantifying in' the RC_2 simultaneously binds both variables P_2 and contributes its information to both the restrictor of the matrix and the embedded NP. This is unwarranted, of course. Janssen (1982) himself points to another problem of a DP-S analysis concerning scope relations with stacked relative clauses. He concludes that only a CN-S analysis can account for these data. However, this option is not available here. The paratactic syntactic analysis of IV2 constructions and the desired interpretations make it necessary to adopt an S-S analysis that makes heavy use of 'quantifying in'. Such an analysis runs into problems similar to the one in (18). For instance, a sentence such as

[6]Thanks to an anonymous reviewer for pointing this out to us.

(21) Eine Norwegerin kennt eine Schwedin, (/) die ist blond.
A Norwegian knows a Swede that is blond.
'A Norwegian knows a Swede who is blond.'

receives an unavailable interpretation that can be paraphrased as *a blond Norwegian knows a blond Swede*, if both DPs share the same syntactic variable do_sth_i.

Maybe unsurprisingly, a compositional analysis is possible by unleashing the full power of the Montagovian framework. However, such an approach is prone to heavy overgeneration and it is hard to see, how an intuitively adequate compositional analysis along the syntactic structure alone could work for these examples. In the next section we propose an interpretation mechanism which is less dependent on syntactic structure but makes heavy use of *information structure* instead.

3 IV2 and Information Structure

In Section 1, we have already mentioned the fact that IV2 clauses do not build a fully separate intonational unit, but have to be integrated into the main clause. Matrix clause and IV2 then form one information structural unit together (cf. Brandt (1990)). This is also evidenced by the fact that focus-sensitive particles such as *sogar (even)* can find their associate within the IV2, which is not self-evident given the paratactic analysis (see Gärtner, 2001, p. 110)[7]:

(22) a. Ich kenne sogar Leute, (/) die lesen CHOMskys Bücher.
I know even people that read Chomsky's books.
'I know people who even read Chomsky's books.'

b. Even Chomsky is an x such that I know people who read x's books

Furthermore, IV2 constructions share certain characteristics with *presentational structures* (Lambrecht, 1988), such as (23).

(23) Once upon a time, there was an old cockroach who lived in a greasy paper bag.

In (23) the matrix clause introduces a new discourse referent (a *pre-topic* as Endriss and Gärtner (to appear) call it) which simultaneously serves as an *(aboutness) topic* of the attached relative clause in the sense of Reinhart (1982). According to (Lambrecht, 1988, p. 322), presentational structures are 'minimal processing units', contrary to a sequence of isolated sentences.

The close connection of the two clauses can be realized in some variants of English by *presentational amalgams*[8] (Lambrecht, 1988, p.319)

(24) There was a farmer had a dog.

[7] Note that *sogar (even)* can associate with elements that are not syntactically c-commanded by it.
[8] also called *contact clauses*

As Lambrecht himself notes, these characteristics are similar in the case of IV2s. Here CP_1 sometimes carries little 'informational content', besides the introduction of a new pre-topic which is used as the topic in CP_2 for predication. Consider the following pair, for instance (see Endriss and Gärtner, to appear).

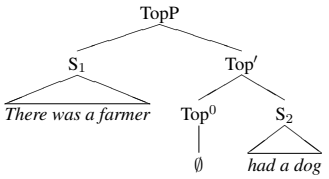
(25) a. Im Sommer gab es plötzlich diesen Moment, (/) da stimmte
In summer gave it suddenly that moment there fitted
einfach alles.
simply everything.
'There was that moment in the summer where everything was perfect.'

b. #Im Sommer gab es plötzlich diesen Moment (\).

The IV2 construction in (25a) is felicitous. Here CP_1 serves the purpose of introducing that moment in summer, of which CP_2 states that it was perfect. On the other hand, CP_1 as an isolated sentence sounds odd due to its little 'informational content' as such.

Yet another point in favour of the topical status of the CP_1 is the fact that (2a) is not good as an answer to *What is there in Apfeldorf?*, which illustrates that the (pre-)topic established in CP_1 and the IV2 clause cannot be focussed together. On the other hand, (2a) is particularly well suited as a reply to *Tell me something about (the houses in) Apfeldorf!*. All these findings let Endriss and Gärtner (to appear) conclude that CP_1 and CP_2 are closely connected and form one information structural unit, in which CP_1 constitutes the topic and CP_2 the focus. This resembles closely the analysis of den Dikken (2005) of presentational amalgams of Lambrecht (1988) which is as follows[9].

(26)



Given these findings, one can make use of the fact elaborated in Herburger (2000), that the semantic arguments of weak quantifiers (in the sense of Milsark (1977)) are determined by information structure. Focal material constitutes the nuclear scope and topical material the restrictor[10], independent of the syntactic

[9] Both den Dikken (2005) and Lambrecht (1988) directly apply their analyses of presentational sentences to IV2-constructions as well. See (Endriss and Gärtner, to appear) for some remarks on why such a direct correspondence does not hold.
[10] In (Herburger, 2000) the decisive category for this mapping is focus alone, whereas we assume it to be topic.

structure[11].

(27) a. Many Scandinavians [won the Nobel prize in LIterature]$_F$
many$[x,\ \mathsf{scandinavian}(x),\ \mathsf{nobel_prize_winner}(x)]$

b. Many [ScandiNAvians]$_F$ won the Nobel prize in literature.
many$[x,\ \mathsf{nobel_prize_winner}(x),\ \mathsf{scandinavian}(x)]$

As the interpretations for each of the above examples show, (27a) can only mean that many Scandinavians are such that they won the nobel prize, whereas (27b) states that many of the Nobel prize winners are Scandinavians. In this latter case, the focussed complement of *many* determines the nuclear scope and the VP the restrictor, although the syntactic structure dictates the exact opposite.

This sensitivity to information structure (and the insensitivity to syntactic structure) is the key to account for IV2 constructions. As argued above, the CP_1 constitutes the topic, whereas the CP_2 contains focal information. Analogously to (27) we hence get the desired interpretations for (1–2a).

(28) [Das Blatt hat eine Seite]$_{\text{TOP}}$, (/) [die ist ganz schwarz]$_F$
$\exists x[\mathsf{page}(x) \wedge \mathsf{have}(\mathsf{sheet}, x) \wedge \mathsf{black}(x)]$

(29) [Apfeldorf hat viele Häuser]$_{\text{TOP}}$, (/) [die stehen leer]$_F$
$\mathsf{many}[x,\ (\mathsf{house}(x) \wedge \mathsf{have}(\mathsf{apfeldorf}, x)),\ \mathsf{vacant}(x)]$

Note that (28) illustrates that for a symmetric quantifier such as *ein (a)* the restrictor cannot be told apart from the nuclear scope. It hence only *seems* that IV2 clauses are interpreted as standard restrictive relative clauses, i.e. in the restrictor. This difference comes out in the case of *many* in (29) where the IV2 clause information ends up in the nuclear scope and yields the desired interpretation.

Concerning verb final clauses, we noted in the preceding section that the interpretation for (2b) is the same as for the IV2 clause. However, this is only true for an 'out-of-the-blue' utterance with a certain information structure. Actually the interpretation should vary with the information structure if we assume the mechanism of Herburger (2000), contrary to IV2 constructions where the information structural properties are restricted as described above[12]. The following examples show that we can indeed apply the same mechanism to derive the desired readings.

[11]Cohen (2001) raises doubt on this analysis of *many* and provides a different analysis, which derives a different interpretation. He argues that his result is actually the correct one and often confused with the interpretation provided by Herburger (2000). However, we doubt that his approach can account for the full range of data. An elaborate discussion would lead to far astray from the topic of this paper.

[12]Following earlier work by Wechsler (1991) and Reis (1997) (among others), Gärtner (2001, 2002) assumes that V2-clauses possess (proto-)assertional force, which prevents them from being fully backgrounded or serving as purely topical information.

(30) A: Kennst du viele Linguisten?
'Do you know many linguists?'
B: (Eigentlich nicht, aber) ich kenne viele Linguisten, die [über IV2 forschen.]$_F$
'(Actually no, but) I know many linguists, who [work on IV2].'
$\mathsf{many}[x,\ (\mathsf{linguist}(x) \wedge \mathsf{know}(\mathsf{I}, x)),\ \mathsf{work\_on\_iv2}(x)]$

(31) A: Was für Bekannte hast du denn so?
'What are your friends like?'
B: Ich kenne (beispielsweise) [viele Linguisten, die über IV2 forschen.]$_F$
'I know [many linguists, who work on IV2], (for instance).'
$\mathsf{many}[x,\ \mathsf{know}(\mathsf{I}, x),\ (\mathsf{linguist}(x) \wedge \mathsf{work\_on\_iv2}(x))]$

(32) A: Hast du schon mit vielen IV2-Forschern zusammengearbeitet?
'Have you collaborated with many IV2 researchers?'
B: (Zusammengearbeitet nicht, aber) ich [kenne]$_F$ (zumindest) viele Linguisten, die über IV2 forschen.
'(I haven't collaborated with them, but at least) I [know] many linguists, who work on IV2.'
$\mathsf{many}[x,\ (\mathsf{linguist}(x) \wedge \mathsf{work\_on\_iv2}(x)),\ \mathsf{know}(\mathsf{I}, x))]$

Despite identical syntactic structure, the meanings of (30–32) differ and are fully determined by information structure, which is induced by the preceding questions.

Another point that can be explained by considering information structure concerns the class of determiners that license IV2 constructions. As already illustrated in (9), some determiners are illicit in these cases.

(33) a. Ich kenne viele / drei Linguisten, (/) die haben rote Haare.
I know many / three linguists that have red hair.

b. * Ich kenne die meisten / wenige / die Linguisten, (/) die haben rote Haare.
I know most / few / the linguists that have red hair.
'I know … linguists, who are redheaded.'

This restriction falls out of the information structural analysis if we combine it with the treatment of topical quantifiers of Ebert and Endriss (2004). First, recall that Herburger's (2000) observation excludes strong quantifiers such as *die meisten (most)* due to their insensitivity to information structure. These quantifiers take their arguments syntactically and hence will be 'saturated' by the material of the

first clause alone. Therefore the IV2 clause cannot be integrated any more. A similar explanation holds for definites[13].

Second, according to the topical status of the entire CP_1 clause, the involved quantifier must be of topical status also. Ebert and Endriss (2004) give a characterization of quantifiers which can be topical, based on their lexical semantics. Their analysis rules out the remaining quantifers in question such as *wenige (few)*[14] (see Endriss and Gärtner (to appear) for details).

In the preceding section we showed that a compositional analysis along the syntactic structure can in principle be sustained for the phenomena at hand, which at first sight seemed to be problematic in this respect. In this section it turned out that an information structural approach can much more naturally account for the data.

4 Conclusion

In this paper we have presented an analysis of German IV2 constructions on the basis of information structure, which extends to restrictive relative clauses. Such an analysis derives distinct readings of the three sentences in (30)–(32). despite their common syntactic structure. Whether this approach can be called compositional depends on the exact implementation of the meaning composition, on which we have not elaborated here. For instance, in Herburger's analysis the determiner is *Q-raised* and then the information structural parts are mapped correspondingly by *focal mapping*. Therefore Herburger arrives at the following LF for (27b).

(34) [[Many won the Nobel Prize in literature][ScandiNAvians won the Nobel Prize in literature]]

Then, obviously, this restructured configuration can be interpreted compositionally. However, due to the necessary restructuring of the syntactic parts prior to interpretation, we would not want to call such an approach fully compositional. Other approaches such as Krifka (1991) use structured meanings to more directly account for the contribution of information structure to semantics. However, the meaning composition still goes along the syntactic structure alone. We would like to think of information structure as a separate level on a par with syntax in an

[13] A Russellian construal of definites is ruled out on the same grounds. An individual type construal leads also to a 'saturation' of the first clause already, without the possibility of further integration of more information. A different explanation is mentioned in Gärtner (2001) and elaborated in Endriss and Gärtner (to appear), where it is argued that a definite containing a familiarity presupposition is incompatible with the proto-assertional character of IV2.

[14] Note that the topical status of *viele (many)* is not entirely clear. Reinhart (1997) regards *many* as a *wide scope indefinite*, i.e. an indefinite that can take scope out of syntactic islands. As Ebert and Endriss (2004) argue, the class of wide scope quantifiers coincides with the class of topical quantifiers, although their approach cannot account for the topical status of *many*. Kamp and Reyle (1993) also see *many* as an indefinite introducing a discourse referent (which eventually classifies *many* as wide scope indefinite).

extended definition of compositionality. For instance, the mapping of topic and focus into the restrictor/nuclear scope could be defined as a compositional operation, because the interpretation of the sentence is determined by the interpretations of its *information structural* parts. This is a rephrased version of the principle of compositionality which is usually assumed to talk about *syntactic* parts. Therefore meaning composition could go along syntactic structure as well as information structure. In fact, following a strand of research exemplified by Pierrehumbert and Hirschberg (1990), we could make more of intonation, i.e. the formal counterpart of information structure, in defining the notion 'part' in an extended compositional framework capable of dealing with the facts discussed here. This would be in line with the discussion in (Janssen, 1997), who repeatedly stresses the point that 'part is a technical notion.' Taking intonation into account, we could derive that, strictly speaking, CP1 cannot stand alone. Also one would be justified in postulating an asymmetry between CP1 and CP2. The latter point is in line with research on *clause combining* such as pursued in the framework of SDRT (Asher and Lascarides, 2003).

References

Asher, Nicholas and Lascarides, Alex. 2003. *Logics of Conversation*. Cambridge University Press.

Bach, Emmon and Cooper, Robin H. 1978. The NP-S analysis of relative clauses and compositional semantics. *Linguistics and Philosophy* 2, 145–150.

Barwise, Jon and Cooper, Robin. 1981. Generalized Quantifiers and Natural Language. *Linguistics & Philosophy* 4, 159–219.

Brandt, Margareta. 1990. *Weiterführende Nebensätze*. Stockholm: Almqvist and Wiksell.

Cohen, Ariel. 2001. Relative readings of *many*, *often*, and generics. *Natural Language Semantics* 9, 41–67.

den Dikken, Marcel. 2005. A comment on the topic of topic-comment. *Lingua* 115, 691–710.

Ebert, Christian and Endriss, Cornelia. 2004. Topic Interpretation and Wide Scope Indefinites. In *Proceedings of the NELS 34*, Amherst: GLSA.

Endriss, Cornelia and Gärtner, Hans-Martin. to appear. Relativische Verb-Zweit Sätze und Definitheit. In Franz-Josef d'Avis (ed.), *Proceedings of the Symposium Deutsche Syntax: Empirie und Theorie, Göteborger Germanistische Forschungen*, Göteborg.

Gärtner, Hans-Martin. 2001. Are there V2 relative clauses in German? *Journal of Comparative Germanic Linguistics* 3, 97–141.

Gärtner, Hans-Martin. 2002. On the Force of V2-Declaratives. *Theoretical Linguistics* 28.

Herburger, Elena. 2000. *What Counts: Focus and Quantification.*. Cambridge, MA: MIT Press.

Janssen, Theo. 1997. Compositionality. In Johan van Benthem and Alice ter Meulen (eds.), *Handbook of Logic and Language*, pages 417–473, Amsterdam: Elsevier.

Janssen, Theo M.V. 1982. Compositional Semantics and Relative Clause Formation in Montague Grammar. In Jeroen Groenendijk, Theo Janssen and Martin Stokhof (eds.), *Formal Methods in the Study of Language*, pages 237–276, Amsterdam: UvA-Publications.

Kamp, Hans and Reyle, Uwe. 1993. *From Discourse to Logic. Introduction to Model-theoretic Semantics of Natural Language, Formal Logic and Discourse Representation Theory*. Studies in Linguistics and Philosophy, No. 42, Kluwer.

Krifka, Manfred. 1991. A Compositional Semantics for Multiple Focus Constructions. In Joachim Jacobs (ed.), *Informationsstruktur und Grammatik, Sonderheft der Linguistischen Berichte*.

Lambrecht, Knud. 1988. There was a farmer had a dog: syntactic amalgams revisited. *BLS* 14, 319–339.

Milsark, Gary. 1977. Toward an Explanation of Certain Pecularities of the Existential Construction in English. *Linguistic Analysis* 3, 1–29.

Partee, Barbara. 1988. Many Quantifiers. In *Proceedings of ESCOL'88*, pages 383–402.

Pierrehumbert, Janet and Hirschberg, Julia. 1990. The Meaning of Intonational Contours in the Interpretation of Discourse. In Philip Cohen, Jerry Morgan and Martha Pollack (eds.), *Intentions in Communication*, pages 271–311, Cambridge, MA: MIT Press.

Reinhart, Tanya. 1982. Pragmatics and Linguistics. An Analysis of Sentence Topics. *Philosophica* 27, 53–94.

Reinhart, Tanya. 1997. Quantifier Scope: How Labour is devided between QR and Choice Functions. *Linguistics & Philosophy* 20, 335–397.

Reis, Marga. 1997. Zum syntaktischen Status unselbstndiger Verbzweit Stze. In Christa Dürscheid (ed.), *Sprache im Fokus*, pages 121–144, Tübingen: Niemeyer.

Wechsler, Stephen. 1991. Verb Second and Illocutionary Force. In Katherine Leffel and Denis Bouchard (eds.), *Views on Phrase Structure*, pages 177–191, Dodrecht: Kluwer.