3. Frameworks for the Representation of Focus Sensitivity

In this section we will discuss various frameworks that have been developed to capture the focus sensitivity of operators like *only*.

3.1 Introduction

3.1.1 Sensitivity to Focus as a Problem for Compositionality

The principle of compositionality (Frege's principle) says that the meaning of a complex expression, $[\![[_X [_Y \alpha\,] [_Z \beta]]]\!]$ can be computed as a function of the meanings of its immediate syntactic parts, $[\![[_Y \alpha\,]]\!]$, $[\![[_Z \beta]]\!]$, and the way these immediate syntactic parts are combined, here, by the phrase structure rule X → Y Z.

(1) $[\![[_{VP} [_{VP}$ *introduced Bill to Sue*$][_{AdvP}$ *in the dining room*$]]\!]$
= $[\![[_{AdvP}$ *in the dining room*$]]\!]([\![[_{VP}$ *introduced Bill to Sue*$]]\!])$
= (roughly, application of further rules)
$\lambda P \lambda x[P(x)$ IN(THE DINING ROOM)$(x)](\text{INTROD}(\text{BILL})(\text{SUE}))$
$= \lambda x[\text{INTROD}(\text{BILL})(\text{SUE})(x)$ IN(THE DINING ROOM)$(x)]$

Semantic representations like INTROD(BILL)(SUE) are to be understood as standing for modell-theoretic objects (e.g., the set of persons x such that x introduced Bill to Sue). We have to distinguish between **denotational** theories and **representational** theories. In denotational theories, semantic representations make reference only to those modell-theoretic objects. In representational theories: Semantic representations may refer to the way these objects are described.

A problem for compositionality with focus-sensitive operators like *only*:

(2) a. *Mary only introduced Bíll to Sue.*
'The only y among a set of alternatives such that Mary introduced y to Sue is y = Bill'
INTROD(BILL)(SUE)(MARY)
y ALT(BILL)[INTROD(y)(SUE)(MARY) → y = BILL]
(where ALT(BILL): The set of relevant alternatives to Bill.)

b. *Mary only introduced Bill to Súe.*
'The only y among a set of alternatives such that Mary introduced Bill to y is y = Sue'
INTROD(BILL)(SUE)(MARY)
y ALT(SUE)[INTROD(BILL)(y)(SUE) → y = SUE]

In both cases we have the syntactic structure $[_{VP}$ *only* $[_{VP} \alpha\,]]$. But then the downstairs VPs of (2.a,b) must have a distinct meaning. The distinct accentuation pattern must lead to semantic differences. In particular, it seems to be necessary that the meaning of the operator *only* can identify the meaning of the focus, *Bill* in (a) and *Sue* in (b). But the operator and the focus do not form a constituent, and it is unclear how the operator can access the focus meaning.

3.1.2 A Classification of Theories of Focus Sensitivity

We will review a number of theories that have been developed to represent the meaning contribution of focus. To classify these theories and discuss their strength and weaknesses, it is helpful to introduce some terminology, which will be illustrated with the following example:

(3) *introduced* $[\textit{Bíll}]_F$ *to Sue*

- F is the **focus feature**. It is assumed that this feature is assigned to a syntactic constituent in the syntactic tree and consequently triggers specific semantic interpretations.
- *Bill* is the **focus**, and BILL is the meaning of the item in focus, or, the **focus meaning**.
- *introduced _ to Sue* is the complement of the focus, the **background**. The background meaning is a lambda abstraction over the focus meaning, $\lambda x[\text{INTROD}(x)(\text{SUE})]$

Obviously, we can give a meaning rule for focus-sensitive operators like *only* once we provide for an access to the focus and to the background. In essence, it will be the following:

(4) ONLY(F)(B) = B(F) x ALT(F)[B(x) → x = F]

But it is not clear that we need access to both focus and background. Actually, the various frameworks can be classified according to which information actually is needed, in addition to the standard meaning of its scope constituent, here INTROD(BILL)(SUE):

- **Double access theories** ($[\![$*only*$]\!]$ accesses both focus meaning and background meaning)
- **Replacive theories** ($[\![$*only*$]\!]$ accesses focus meaning only)
- **In Situ Binding Semantics** ($[\![$*only*$]\!]$ accesses background meaning only)
- **Alternative Semantics** ($[\![$*only*$]\!]$ accesses neither background nor focus meaning)

3.2 Double Access Theories

There are various theoretical frameworks of the double access type. We can roughly classify them into two categories: Those that accomplish association with focus in syntax, and those that accomplish association with focus in semantics.

3.2.1 Focus Movement

3.2.1.1 How does it work?

One popular theory that goes back to Chomsky (1976) assumes that the focus feature triggers movement of the focus on logical form (LF). This movement identifies the background and the focus for the operator. We can assume that LF focus movement adjoines the focus to the scope of the operator, and that this LF then is the input for semantic interpretation:

(5) a. S-structure: $[_{VP}$ *only* $[_{VP}$ *introduced Bíll*$_F$ *to Sue*$]]$

b. LF: $[_{VP}$ *only* $[_{VP}$ *Bill*$_1$ $\lambda t_1[_{VP}$ *introduced* t_1 *to Sue*$]]]$

c. Meaning rule for adverbial *only*:
$[\![$*only* [F B]$]\!]$
$= [\![$*only*$]\!]([\![$F$]\!])([\![$B$]\!])$
$= \lambda x[[\![$B$]\!]([\![$F$]\!])(x) \quad y \ \ ALT(BILL)[[\![B]\!](y)(x) \rightarrow y = [\![F]\!]]]$

d. $[\![$*Bill*$]\!]$ = BILL,
$[\![\lambda t_1[_{VP}$ *introduced* t_1 *to Sue*$]]\!] = \lambda x_1[$INTROD(x_1)(SUE)$]$,
$[\![[_{VP}$ *only* $[_{VP}$ *Bill*$_1$ $\lambda t_1[_{VP}$ *introduced* t_1 *toSue*$]]]\!]$
$= \lambda x[$INTROD(BILL)(SUE)(x)
y ALT(BILL)[INTROD(y)(SUE)(x) $\rightarrow$ y = BILL]]

3.2.1.2 An argument from weak crossover

It seems that focus movement showes so-called **weak crossover effects**.

Background: First, notice that cataphoric pronominal chains are possible:

(6) a. [The man that she$_1$ met] liked Mary$_1$.

b. [His$_1$ dog] likes John$_1$.

But the following cataphoric chains lead to ungrammaticality:

(7) a. *Who$_1$ does the man that she$_1$ met like t_1?

b. *Who$_1$ does his$_1$ dog like?

(8) a. *The man that she$_1$ met liked every woman$_1$.
LF: every woman$_1$ [the man that she$_1$ met liked t_1]

b. *His$_1$ dog likes everyone$_1$.
LF: everyone$_1$ [his$_1$ dog likes t_1]

Chomsky (1976) captured these data with the **leftness condition**, stating that a pronoun cannot be coindexed with a variable to its right.

Now, Chomsky cites similar cases involving focus that can be explained in the same way if we assume a LF-movement analysis of focus.

(9) a. *The man that she$_1$ met liked Máry$_{F,1}$
LF: Mary$_1$ [the man that she$_1$ met liked t_1]

b. *His$_1$ dog likes Jóhn$_{F,1}$
LF: John$_1$ [his$_1$ dog likes t_1]

This seems a strong motivation for the focus movement analysis.

However, Rochemont (1986) observes that there are cases in which the weak crossover constraint seems to be violated:

(10) A: Sally and the woman John loves is leaving the country today.
B: I thought that the woman he loves has betráyed$_F$ Sally.
A: No, the woman he loves has betrayed Jóhn$_F$

Rochemont sees this as an instance of **contrastive focus**, and claims that in this case we do not have an anaphoric chain within the sentence; rather the pronoun refers to *John* in the preceding sentence.

But the weak crossover data do not constitute a good argument for the LF movement theory of focus after all, for the data in (9) can be explained in other ways. We observe that expressions in focus cannot refer to something given in the immediate context, except when used contrastively.

(11) a. *John and Mary danced on the floor. Then [Jóhn]$_F$ kissed Mary.

b. Mary kissed John, and then [Jóhn]$_F$ kissed [Máry]$_F$.

This generalization has been captured in various ways, e.g. by the notion of "c-construable" by Rochemont (1986) (see further discussion later). It would cover the fact that (9.a,b) are bad, without appealing to any weak crossover violation.

3.2.1.3 A problem with focus in syntactic islands

Focus movement theories are problematic because they rely on a mechanism that is commonly used to express the scope of operators (see e.g. LF movement as a mechanism to capture operator scope in May (1985)). But operator scope is restricted by syntactic islands, as in overt movement:

(12) a. [overt movement]:
*[Which hat]$_1$ did Sam see $[_{NP}$a man $[_{CP}$ who was wearing $t_1]]$?

b. [LF movment]:
Sam saw a man who was wearing most hats.
*[most hats]$_1$ [Sam saw $[_{NP}$ a man $[_{CP}$ who was wearing $t_1]]$.

But association with focus disregards syntactic islands (cf. Anderson (1972), Jackendoff (1972)):

(13) Sam only saw $[_{NP}$ a man $[_{CP}$ who was wearing a [réd]$_F$ hat]]

Other problems (cf.Wold (1995)):

(14) a. Mary only$_1$ asked Bill which boy$_2$ will bring [his$_2$ móther]$_{F1}$.

b. Mary only$_1$ [his$_2$ mother] λt_1[$_{VP}$ asked Bill which boy$_2$ will bring t_1]

(15) a. Mary only$_1$ thought that every boy would bring [a téddy bear]$_{F1}$.

b. Mary only$_1$ [a teddy bear]$_{F1}$ λt_1[$_{VP}$ thought that every boy would bring t_1]

In (14.b), *his* cannot be bound by *which boy*. In (15.b), we only get a wide-scope reading of *teddy bear* over *every boy*.

3.2.2 Focus Operator Movement

3.2.2.1 How does it work?

Sgall (1986) work with a syntactic theory that distinguishes between a surface structure and a **tectogrammatical structure** on which the expressions are linearly ordered according to their **communicative dynamism**, with the most thematic, or known, elements ranking to the left, and the most rhematic, or new, elements ranking to the right. I use "||" to mark the topic-focus boundary.

(16) Chárles$_F$ came to the party.

CD: *to the party* | *came* || *Charles*

Focus-sensitive operators like *only* are seen as "focalizers" that immediately precede the most rhematic element. From there it may be moved to its surface-structure position:

(17) a. CD ranking: *Mary* | *met* || *John*

b. Insertion of *only*: *Mary* | *met* | *only* || *John*

c. Realisation 1: *Mary met only Jóhn.*

d. Realisation 2: *Mary only* [*met Jóhn*]

(18) a. CD ranking: *Mary* || *met* | *John*

b. Insertion of *only*: *Mary* || *only* | *met* | *John*

c. Realisation: *Mary only met Jóhn*.

The two realizations of (17) have the same meaning, which is distinct from the meaning of (18); however, the two realizations (17.d) and (18.c) are identical.

3.2.2.2 Problems

One problem, similar to the problems of focus movement, was pointed out already by Jackendoff (1972, p. 250, footnote 4). The relation between the focus operator in surface position and its trace may be syntactically unbounded:

(19) Sam only$_1$ saw [$_{NP}$ the man [$_{CP}$ who was wearing [t_1 [a báseball cap]]]]

Another problem: (19) differes in meaning from the following example, which is supposed to be its underlying source:

(20) Sam saw the man who was wearing only a báseball cap.

Another problem: multiple focus constructions:

(21) Nobody reads Goethe's poetry here anymore.
Even Péter knows only the nòvels by Goethe.

If every sentence has just one boundary between topic and focus, and if focus-sensitive operators originate at this boundary, then it is unclear how examples with two or more such expressions that operate on distinct constituents should be analyzed.

Another problem: Multiple focus.

(22) Mary only introduced Bíll$_F$ to Jóhn$_F$.
'The only pair x, y such that John introduced x to y
is x = Bill and y = Sue'

We would have to assume that *only* originates from two different places.

3.2.3 Structured Meanings

The double access theories discussed so far provided access to the focus and to the background through a specific level of syntactic structure. There are other theories that do the same in semantics.

3.2.3.1 Jackendoff (1972): Presupposition skeletons

Jackendoff (1972, chapter 6.4). suggests the following way in which focus information can be made accessible. First, focus assignment leads to the interpretation of an expression as two formal objects, namely the standard meaning, and a meaning in which the focus is replaced by a variable (the **presupposition skeleton**, cf. Rooth (1985)). In a second step, the free variable in the presupposition skeleton is abstracted over, leading to a set, the **presuppositional set**. This presuppositional set then is used for the interpretation of the sentence.

(23) a. *Mary met Bíll*$_F$.

b. Standard meaning: MET(BILL)(MARY)
Presupposition skeleton: MET(x)(MARY)

c. Presupposition set: λx[MET(x)(MARY)]

The presupposition set can be used to render focus sensitivity. If $[\![\alpha]\!]_O$ is the ordinary meaning, $[\![\alpha]\!]_P$ is the presupposition set, and $[\![\alpha]\!]_F$ is the meaning of the item in focus of the scope α of *only*, then we can write rules for the interpretation of *only* as follows:

(24) $[\![only]\!]([\![\alpha]\!]) = \lambda x[[\![\alpha]\!]_O(a) \quad y[[\![\alpha]\!]_P(y)(x) \rightarrow y=[\![\alpha]\!]_F]]$

We do not have to assume any syntactic movement; however, the price for that is a considerably more refined semantic representation. But Jackendoff (1972) does not indicate how the semantic representation involved here set can be derived compositionally.

3.2.3.2 Structured Meanings

An approach that is quite related to Jackendoff's is to use **structured meanings** for the representation of focus. This also allows for a compositional analysis.

A structured meaning is a pair (or n-tuple) of regular meanings $\langle \alpha, \beta \rangle$ such that α can be applied to β, i.e. $\alpha(\beta)$ is well-formed. In contrast to $\alpha(\beta)$, the structured meaning $\langle \alpha, \beta \rangle$ allows that operators access the parts α and β separately. Hence, structured meanings are a way to get around strict compositionality.

We can make use of structured meanings for our purpose by interpreting expressions that contain a focus by structured meanings $\langle B, F \rangle$, where B stands for the meaning of the background, and F stands for the meaning of the focus. This use of structured meanings was suggested by Jacobs (1983) and Stechow (1990).

Structured meanings also allow for a compositional way of dealing with focus, cf. Krifka (1992). Let us have a look at this system.

(25) Definition of types:

(i) e, t are types (entities, truth values);

(ii) if τ and σ are types, then $(\tau)\sigma$ is a type
(of functions from τ-denotations to σ-denotations)

(iii) if $\sigma, \tau_1, \ldots \tau_n$ are types, then $(\tau_1)\ldots(\tau_n)\sigma, \tau_1 \ldots \tau_n$ is a type
(of a background–focus structure with background $(\tau_1)\ldots(\tau_n)\sigma$ and foci $t_1 \ldots t_n$)

Types that are defined by (iii) as the final step in the derivation are **structured**, and all other types **simple**.

Combinatorial properties of expressions of certain types:

(26) Recursive definition of extended functional application "{ }".

(i) If α is of type $(\tau)\sigma$ and β is of type τ, then $\alpha\{\beta\} = \alpha(\beta)$.

(ii) If α is of a simple type τ, β is of a type $(\rho)(\tau)\sigma$,
and γ is of type ρ, then
$\beta\rho\{\alpha\} = \lambda X[\beta\{X\}\{\alpha\}], \gamma$,
where X is a variable of type ρ not occurring free in β or α.

(iii) If α is of a type $(\tau)\sigma$, β is of a type $(\rho)\tau$, and γ as before,
then $\alpha\{\beta\gamma\} = \lambda X[\alpha\{\beta\{X\}\}], \gamma$,
where X is a variable of type ρ not occurring free in β or α.

Application: Focus introduces a structured meaning (27), and the information about the item in focus, and where this item is to be interpreted within the background, is projected in the later semantic combinations.

(27) $[\![A_F]\!] = \lambda X[X], [\![A]\!]$, where X is a variable of the type of $[\![A]\!]$.

(28) Derivation of $[_{VP}$ [*introduced Bíll*$_F$] *to Sue*]

a. $[\![Bíll_F]\!] = \lambda X[X], [\![Bill]\!]$, $= \lambda X[X]$, BILL , type (e)e, e

b. $[\![introduced]\!]$ = INTROD, type (e)(e)(e)t.

c. $[\![introduced\ Bíll_F]\!]$
$= [\![\text{introduced}]\!]\{[\![Bíll]\!]_{F|}\}$,
$= \text{INTROD}\{\ \lambda X[X], \text{BILL}\ \}$
$= \lambda X_1[\text{INTROD}\{\lambda X[X]\{X_1\}\}], \text{BILL}$,
$= \lambda X_1[\text{INTROD}(X_1)], \text{BILL}$,
type (e)(e)(e)t, e , used rule: (26.iii).

d. $[\![introduced\ Bíll_F\ to\ Sue]\!]$
$= [\![introduced\ Bíll_F]\!]\{[\![Sue]\!]\}$,
$= \lambda X_1[\text{INTROD}(X_1)], \text{BILL}\ \{\text{SUE}\}$,
$= \lambda X_1[\lambda X_1[\text{INTROD}(X_1)](X_1)\{\text{SUE}\}], \text{BILL}$,
$= \lambda X_1[\text{INTROD}(X_1)(\text{SUE})], \text{BILL}$
type (e)(e)t, e , used rule: (26.ii)

Application of *only*, an operator of type $(\ (\tau)(e)t,\tau\ )(e)t$, where τ can be any type:

(29) [*only* $[_{VP}$ [*introduced Bíll*$_F$] *to Sue*]]:

$= [\![only]\!]([\![introduced\ Bíll_F\ to\ Sue]\!])$

$= \lambda\ B, F\ \lambda x[B(F)(x)$
$\quad y\ \ ALT(B)[B(y)(x) \rightarrow y = F]](\ \lambda X_1[\text{INTROD}(X_1)(\text{SUE})], \text{BILL}\ )$

$= \lambda x[\text{INTROD}(\text{BILL})(\text{SUE})(x)$
$\quad y\ \ ALT(\text{BILL})[\ \text{INTROD}(y)(\text{SUE})(x) \rightarrow y = \text{BILL}]]$

Krifka (1992) shows that this format can handle cases with **complex and multiple focus** as well:

(30) a. Mary only introduced Bíll$_F$ to Súe$_F$.

b. John tried very hard to behave well at the party,
he even [only drank wáter$_F$]$_F$

c. John drank water; he even$_1$ [ónly$_2$]$_{F1}$ drank water$_{F2}$.

3.2.4 A General Problem of Double Access Theories

Rooth (1992) points out a general problem of double access theories: They allow for focus-sensitive operators that do not occur in natural languages. Rooth's example is a verb *tolfed* that has the following meaning, given by schematic example:

(31) a. *tolfed* [*that* ... X_F ...] = *told* X [*that* ...X_F...]

b. *I tolfed that hé*$_F$ *resembles her*. 'I told him that he resembles her'

c. *I tolfed that he resembles hér*$_F$ 'I told him that he resembes her'

Rooth's conclusion is that theories that allow for access to the focus item are too powerful.

Notice that the hypothetical verb *tolfed* does not make any reference to the alternatives of the focus meaning. It seems that every legitimate focus-sensitive operator makes use of the alternatives.

Exercise: Consider a case of so-called complex focus:

Mary only introduced Bíll$_F$ *to Súe*$_F$.

Show how this sentence can be analyzed within the LF-movement theory of focus. That is, give an appropriate surface structure and a logical form, and show how the operator *only* can derive from this logical form the proper reading (roughly, 'the only x, y such that Mary introduced x to y are x = Bill and y = Sue').

3.3 Replacive Theories

Replacive theories of focus sensitivity make use of just the focus. They retrieve the position at which the focus is interpreted by some syntactic matching process.

(32) *only introduced Bíll*$_F$ *to John*:

$\text{ONLY}(\text{BILL}, \text{INTROD}(\text{BILL})(\text{JOHN})(x))$

$= \lambda x[\text{INTROD}(\text{BILL})(\text{JOHN})(x)$

$\quad y[y \in \text{ALT}(\text{BILL})[[\text{INTROD}(\text{BILL})(\text{JOHN})]^{\text{BILL}/y}(x) \rightarrow y = \text{BILL}]]$

Here, $\alpha^{\text{BILL}/y}$ stands for an expression like α, except that all occurrences of the term BILL are replaced by y.

Ways of implementing the replacement operation: Pulman (1995), Gardent & Kohlhase (1996) for versions using higher-order unification, and Hoepelman (1979) for an earlier, less sophisticated version. Replacement is seen as an operation that is not sensitive to syntactic structure, hence not sensitive to syntactic island constraints.

Problems:

- Presupposes a semantic representation language, as term replacement is a syntactic operation; many semantic theories (like classical Montague grammar) do not.
- Replacive theories are insensitive for multiple occurrences of the focus expression, which leads to a wrong analysis for the following example:

(33) Mary only compared Jóhn$_F$ with John's mother.
'The only x such that Mary compared x with John's mother is x = John'

A simple replacive theory would assign (33) the wrong reading, 'the only x such that Mary compared x with x's mother is x = John'. To get around this problem, one would have to identify occurrences of expressions in focus, which essentially leads us back to some version of the double access account.

3.4 Alternative Semantics

3.4.1 How it works

Alternative Semantics (Rooth (1985; Rooth (1992; Stechow (1990) distinguishes between two dimensions of meaning, the **ordinary meaning** $[\![\ ]\!]_O$ and the **alternatives** $[\![\ ]\!]_A$. The alternatives are sets of meanings of the type of the ordinary meaning. Whenever two ordinary meanings $[\![\alpha]\!]_O$, $[\![\beta]\!]_O$ are combined by a semantic rule, e.g. by functional application to $[\![\alpha\ \beta]\!]_O = [\![\alpha]\!]_O([\![\beta]\!]_O)$, then the alternatives are the set of all corresponding combinations of the elements of the alternatives of the parts: $[\![\alpha\ \beta]\!]_A = \{X(Y) |\ X \in [\![\alpha]\!]_A,\ Y \in [\![\beta]\!]_A\}$. Expressions in focus introduce alternatives; other expressions do not (that is, their set of alternatives is just the singleton of the ordinary meaning).

Example; in the following, $\wedge\alpha$ stands for the intension of the expression α (a function from possible worlds w to what α means at w), and $\check{}\alpha$ for the extension of an intensional expression α (that is, what α means at the current world w). Notice that we have $\alpha = \check{}\wedge\alpha$.

(34) a. $[\![\textit{Bíll}_F]\!]_O = \text{BILL}$

$[\![\textit{introduced}]\!]_O = \text{INTROD}$

$[\![\textit{introduced Bíll}_F]\!] = [\ \text{INTROD}(\ \text{BILL})],\ = [\text{INTROD}(\text{BILL})]$

$[\![\textit{John}]\!]_O = \text{JOHN}$

$[\![\textit{introduced Bíll}_F \textit{ to John}]\!] = [\text{INTROD}(\text{BILL})(\text{JOHN})]$

b. $[\![\textit{Bíll}_F]\!]_A$ = ALT(BILL)
$[\![\textit{introduced}]\!]_A$ = { INTROD }
$[\![\textit{introduced Bíll}_F]\!]_A$
= { [X(y)]| X $[\![\textit{introduced}]\!]_A$, y $[\![\textit{Bíll}_F]\!]_A$}
= { [INTROD(y)]| y ALT(^BILL)}
$[\![\textit{John}]\!]_A$ = { JOHN }
$[\![\textit{introduced Bíll}_F \textit{ to John}]\!]_A$ = { [INTROD(y)(JOHN)]| y ALT(^BILL)}

c. Meaning rule for adverbial *only*:
$[\![\textit{only VP}]\!]_O$ = λx[$[\![VP]\!]_O$(x) P $[\![VP]\!]_A$[P(x) → P = $[\![VP]\!]_O$]]

d. $[\![\textit{only introduced Bíll}_F \textit{ to John}]\!]_A$
= λx[INTROD(BILL)(JOHN)(x)
P { [INTROD(y)(JOHN)]| y ALT(BILL)}
[P(x) → P = [INTROD(BILL)(JOHN)]]

If applied to MARY, we arrive at a proposition that is true whenever Mary introduced Bill to John, and it holds for every property of the form 'introduce y to John' where y ranges over alternatives to Bill, that if P is true of Mary, then P is actually the property 'introduce Bill to John'. What this comes down to is that the only person y, among the alternatives to Bill, such that Mary introduced y to John is y = Bill.

Notice that the operator *only* does not really "associate" with the focus item. Rather, focus leads to the creation of alternative meanings for the scope of *only*, and *only* makes use of those alternatives.

Exercise: Derive the reading of the complex focus sentence *Mary only introduced Bíll$_F$ to Súe$_F$* within Alternative Semantics.

Exercise: Analyze the following sentence with focus-sensitive negation within Alternative Semantics: *Mary didn't introduce Bíll$_F$ to Sue.* You will have to give a meaning rule for the negation operator. It should follow from this sentence that Mary introduced someone else to Sue.

3.4.2 Discussion

3.4.2.1 Attractive features

- The meaning of the item in focus, BILL, is not directly accessible at the VP level, hence focus-sensitive operators could never apply manipulations that are necessary for an operator like *tolfed*.
- The propagation of alternatives is a non-syntactic process, and so we should not expect any island sensitivity.
- We do not have the problems of the replacive theories; in particular, examples like (33) can be handled well, as only one occurrence of *John* may introduce focus alternatives.

3.4.2.2 The Heart/Kidney Problem

The heart/kidney problem: (34.d) does not precisely express the correct truth conditions, a problem that Rooth (1985) tried to avoid by going intensional, but that cannot be completely eliminated. This was observed already by Rooth (1985, ch. 2, fn. 13). Blok (1993) discusses the following example: Assume a common ground in which everything that has a heart also has kidneys, and that kidneys are in the set of alternatives to hearts. Then the sentence *John only has* [*a heart*]$_F$ turns out to be true if John has a heart *and* kidneys, as the properties *have a heart* and *have kidneys* have the same meaning — they apply to the same individuals in all realistic possible worlds. This is contrary to what we expect. Theories that have direct access to the meaning of the focus expression do not have this problem, as kidneys and hearts are distinct objects even in this common ground.

3.4.2.3 A Problem with Multiple Focus

Another problem appears in certain instances in which more than one focus-sensitive operator occurs within one clause, as in the second sentence of the following example, where the intended associations are marked by coindexing:

(35) Mary only [$_{VP}$ introduced Bíll$_F$ to Sue].
Mary also$_2$ only$_1$ [$_{VP}$ introduced Bìll$_{F,1}$ to Jóhn$_{F,2}$]

Alternative semantics wrongly predicts association of both foci with *only*. We have the following alternative interpretation of the VP, and the first operator to be applied to it, *only*, would make use of the variation introduced by the two foci simultaneously:

{ INTROD(y)(z)| y ALT(BILL), z ALT(JOHN)}

We may assume that *Jóhn* is LF-moved, creating structures like (36.a). However, Rooth (1995) realizes that this movement would be syntactically unbounded (b), and hence would run into precisely the problem that Alternative Semantics tries to avoid.

(36) a. Mary [$_{VP}$ also [$_{VP}$ [John$_F$] λt$_1$[$_{VP}$ only introduced Bill$_F$ to t$_1$]]]

b. John only introduced Bíll$_F$ to the woman that wore the red hat.
He also$_2$ only$_1$ introduced Bìll$_{F,1}$ to the woman that wore the gréen$_{F,2}$ hat.

Another possibility is to assume that *Bill* is not in focus in the second sentence of (b). Rather, the quantificational domain of *only* is fixed by the first sentence, and taken over from there (cf. Fintel (1994)). There are a number of problems with this analysis of multiple focus in so-called second occurrence expressions (cf. Krifka

(1995, to appear)). More importantly, we find instances of multiple focus like the following:

(37) After Christmas a year ago turned into that gift-giving orgy, everyone tried to be more restrained this year. Mary was particularly careful to avoid the usual excesses,
she even$_2$ only$_1$ gave [a little vàse]$_{F1}$ to [her móther]$_{F2}$.

In such cases, no repetition of previous material is involved, and the quantificational domains of *only* and *even* have to be fixed with respect to the indicated foci.

3.4.2.4 A problem with ellipsis

A related problem was pointed out by Kratzer (1994) with the following example:

(38) A: What a copycat you are! You went to Block Island because I did,
you went to Elk Lake Lodge because I did,
and you went to Tanglewood because I did.

B: No, I only went to Tánglewood$_F$ because you did.

Spell-out of VP ellipsis as in (39.a) leads to the analysis (b). The proper analysis, however, is (c). But this requires some sort of coindexation between the two foci that cannot be achieved within Alternative Semantics.

(39) a. I only went to Tánglewood$_F$ because you went to Tánglewood$_F$.

b. The only places x, y such that I went to x because you went to y is x = Tanglewood and y = Tanglewood.

c. The only place x such that I went to x because you went to x is x = Tanglewood.

The problem with multiple foci and the problem with VP ellipsis arise because Alternative Semantics cannot express anything like the binding of variables. It does not make available the means to coindex a focus-sensitive operator with a focus, something like *only*$_x$[...x...], and it does not allow for the expression of coindexation within foci, something like *only*$_x$[...x...x...]. In a sense, it provides only one type of variable, a wildcard, that can be matched locally with any element of the right type, something like *only*[...*...] and *only*[...*...*...]. Evidently, wildcards are computationally simpler than true variables, but the problems discussed here may suggest that they are too simple to express what is going on in association with focus.

3.4.2.5 A problem with correlated complex focus

The following problem was observed by Zimmermann (see Stechow 1990, Kratzer 1994). This is the version of Kratzer:

(40) [We are looking at a group of children about to leave for summer camp. There are quite a number of siblings in the group. Bill is the older brother of Mary.]
A: Are there many girls in the group that are taller than their older brother?
B: No, I don't think so. I can only see that Máry$_F$ is taller than Bíll$_F$.

Alternative semantics leads to the following analysis:

(41) $[\![$see that Máry$_F$ is taller than Bíll$_F]\!]_O$
$= {}^{\wedge}$SEE($^{\wedge}$TALLER($^{\wedge}$MARY, $^{\wedge}$BILL))
$[\![$see that Máry$_F$ is taller than Bíll$_F]\!]_A$
$= \{{}^{\wedge}$SEE($^{\wedge}$TALLER(X, Y)| X $\in$ ALT($^{\wedge}$MARY), Y $\in$ ALT($^{\wedge}$BILL)$\}$, = A
$[\![$only see that Máry$_F$ is taller than Bíll$_F]\!]$ =
λx[SEE($^{\wedge}$TALLER($^{\wedge}$MARY, $^{\wedge}$BILL))
P $\in$ A[$\check{}$P(x) $\rightarrow$ P = $^{\wedge}$SEE($^{\wedge}$TALLER($^{\wedge}$MARY, $^{\wedge}$BILL))]

This says that the only pair x, y such that x is taller than y is x = Mary and y = Bill. But in the given context, we only talk about pairs of girls and their older brothers. It is unclear how this restriction can be expressed in alternative semantics. Alternative semantics can incorporate contextual restrictions for simple foci (the function ALT may be context-sensitive), but not for complex foci (in the case of hand, the restriction could not be expressed for ALT($^{\wedge}$MARY) and ALT($^{\wedge}$BILL) separately).

3.4.3 In-situ Binding Semantics

Wold (1995; Wold (1996) has developed a way of handling focus sensitivity that avoids the shortcomings of Alternative Semantics, without making available the meaning of the expression in focus.

Association with focus is expressed by coindexing in syntax, which may be seen as an instance of anaphora. So we may call it **In-situ Binding Semantics**. Anaphoric relations, in contrast to syntactic movement, may be syntactically unbounded, as illustrated in the following example involving a pronoun, and hence circumvents the major problem of the movement theories:

(42) Mary$_1$ shouted at the man who had sat down on her$_1$ hat.

Expressions are interpreted with respect to a partial variable assignment g that records, in its domain, the indices of the active binders. This is just as theories of dynamic interpretation in general handle anaphoric relations (cf. e.g. Heim 1982, ch. III). We have the following rule for the interpretation of an expression α that is marked by a focus feature with index i:

(43) $[\![\alpha_{F,i}]\!]^g = g(x_i)$, if $x_i \in$ DOM(g),
$= [\![\alpha]\!]^g$, else.

Here, x_i is a variable of the type of α. Focus operators extend the domain of variables. I will use the following notation for the extension of a function g to a function h that has an additional set of variables I in its domain:

(44) $g <_I h$ iff g and h are functions, $I \cap DOM(g) =$, $DOM(h) = DOM(g)$ I, and x DOM(g): $g(x)=h(x)$.

The meaning rule for *only* then can be given as follows:

(45) $[\![only_I\ \alpha]\!]^g = \lambda x[\ [\![\alpha]\!]^g(x)$ $h[g <_I h$ $[\![\alpha]\!]^h(x) \rightarrow [\![\alpha]\!]^h = [\![\alpha]\!]^g]]$

Notice that the first conjunct, α, the scope of *only*, is evaluated with respect to the assignment g that does not yet contain the indices I introduced by *only*. This means according to

(43) that the expressions in focus are interpreted as usual. In the second conjunct, α is interpreted with respect to the changed assignment h, that is, the expressions in focus are replaced by variables, and the quantification over variable assignments h amounts to a quantification over those variables.

With 1 DOM(g) and 1 DOM(h), this amounts to the following:

(46) $\lambda x[\text{INTROD}(\text{BILL})(\text{JOHN})(x)$
$h[g <_{\{1\}} h$ $\text{INTROD}(1)(\text{JOHN})(x) \rightarrow$
$\text{INTROD}(1)(\text{JOHN}) = \text{INTROD}(\text{BILL})(\text{JOHN})]]$

If we apply this predicate to MARY, then we will get a proposition saying that Mary introduced Bill to John, and for every element 1 such that Mary introduced 1 to John, it holds that the predicates 'introduce 1 to John' and 'introduce Bill to John' are identical. As in the meaning rule in Alternative Semantics, this amounts to saying that Mary introduced Bill and nobody else to John.

We can deal with cases of multiple focus and focus in VP ellipsis.

(47) $[\![Mary\ also_{\{2\}}\ only_{\{1\}}\ [_{VP}\ introduced\ Bìll_{F,1}\ to\ Jóhn_{F,2}]]\!]$

Exercise: derive the meaning of

(47), using the following representation of the sentence and meaning rule for *also*:

(48) $[\![also_I\ \alpha]\!]^g = \lambda x[\ [\![\alpha]\!]^g(x)$ $h[g <_I h$ $[\![\alpha]\!]^h(x)$ $[\![\alpha]\!]^h \neq [\![\alpha]\!]^g]]$

In-Situ Binding Semantics does not have the problem of over-expressiveness that we discussed above for hypothetical verbs like *tolfed*, as it does not allow to identify the expression in focus. But precisely because of that reason it inherits the *heart/kidney* problem of under-expressiveness.

Anderson, S.R. (1972). How to get 'even'. *Language, 48,* 893-905.

Blok, P. (1993). *The interpretation of focus. An epistemic approach to pragmatics.* Ph.D. Thesis, Rijksuniversiteit Groningen.

Chomsky, N. (1976). Conditions on Rules of Grammar. *Linguistic Analysis, 2,* 303-350.

Fintel, K.v. (1994). *Restrictions on quantifier domains*. Ph.D. dissertation, University of Massachusetts.

Gardent, C., & Kohlhase, M. (1996). Focus and higher-order unification. Saarbrücken: Computerlinguistik.

Hoepelman, J.P. (1979). Negation and denial in Montague Grammar. *Theoretical Linguistics, 6,* 191-209.

Jackendoff, R. (1972). *Semantic Interpretation in Generative Grammar*. Cambridge, Mass.: MIT Press.

Jacobs, J. (1983). *Fokus und Skalen. Zur Syntax und Semantik der Gradpartikel im Deutschen*. Tübingen: Niemeyer.

Kratzer, A. (1994). The representation of focus. In A.v. Stechow & D. Wunderlich (Eds.), *Handbook of Semantics* (pp. 825-834). Berlin: Walter de Gruyter.

Krifka, M. (1992). A Compositional Semantics for Multiple Focus Constructions. In J. Jacobs (Ed.), *Informationsstruktur und Grammatik.* . (pp. 17-53). Opladen: Westdeutscher Verlag.

Krifka, M. (1995, to appear). Focus and/or context: A second look at second occurrence expressions. H. Kamp & B. Partee (Eds.), *Contextual dependence in the analysis of linguistic meaning*, Prague and Bad Teinach.

May, R. (1985). *Logical Form: Its Structure and Derivation*. Cambridge, Massachusetts: MIT Press.

Pulman, S.G. (1995). Higher-order unification and the interpretation of focus. *Ms.*
Rochemont, M.S. (1986). *Focus in Generative Grammar*. Amsterdam/ Philadelphia: J. Benjamins.

Rooth, M. (1985). *Association with Focus*. Ph.D., University of Massachusetts at Amherst.

Rooth, M. (1992). A Theory of Focus Interpretation. *NLS, 1,* 75-116.

Rooth, M. (1995). Focus. In S. Lappin (Ed.), *The handbook of contemporary semantic theory* (pp. 271-298). Oxford: Blackwell.

Sgall, P.H., Eva; Panevova, Jarmila (1986). *The Meaning of the Sentence in its Semantic and Pragmatic Aspects*. Dordrecht: Reidel.

Stechow, A.v. (1990). Focusing and Backgrounding Operators. Discourse Particles, *Abraham, Werner* (pp. 37-84). Amsterdam: John Benjamins.

Wold, D. (1995). *Binding foci in situ*. Ms., MIT.

Wold, D. (1996). Long distance selective binding: The case of focus., *Semantics and Linguistic Theory (SALT) 6* (pp. 311-328).